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Hyperirritability of Oral Tissues Effects on Salivation *vs*. Dentures

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Abstract

Aim: To investigate aspects that develop the issues bump into denture construction as per saliva physical components (serous and mucous).

Materials and Methods: Under normal resting conditions, the pH of parotid, sublingual, submaxillary, and mixed salivary secretions were defined for healthy subjects (sample size (N) = 40; repeatability (n) = 5) and the impacts of stimulation on saliva flow rate and hydrogen ion concentration were tested. A patient (male; 59 years) had complaints of ankle edema, dyspnoea, edentulous, equally poor dental prognosis, inability to eat with dentures, and partial facial paralysis and loss of speech. Dentures were inserted. Pilocarpine or lemon flavour were administered before meals. A 2nd patient (female; 57 years) suffered from swelling of lips with fissuring, burning, scaling, desquamation, and dehydration. The anterior and posterior teeth were discoloured and prone to dissolution. She was left on diet rich of vitamins. The aphthae were treated directly with copper sulphate, followed with a sodium bicarbonate rinse and the ulceration was healed. The lips were treated effectively to retain the moisture. Moreover, a special formula was prescribed to stimulate the combined secretions of the parotid, the sublingual, and the submaxillary glands.

Results: The preliminary study proves acid nutrients have neutralised both by dilution and by buffer action. The pH of saliva for the first participant (male) was 4.5. The drinking of cola beverage did not stimulate any salivary response associated with oral dehydration. At end of treatment, the patient suffered from lobar pneumonia and deceased after 14-months of treatment. The pH of saliva for the second participant (female) was 4.5 and upon stimulation with cola beverage attained 4.7, referring to very little buffering response. Pilocarpine and Stilbestrol showed positive remarks on salivation. Practicing soft diet is highly suggested for similar medical conditions. Consequently, saliva does not secrete at low pH and the depressed pH is the direct effect of the acidogenic organisms' activities found in the mouth.

Conclusion: For patients as with edentulous, before wearing dentures, dentists are advised to check the appearance of oral tissues, in addition to such signs as redness, swelling, dehydration, and depressed oral pH.

Keywords: *Paranasal Sinuses; Maxillary Sinus; Sinusitis; Dental Practice*

Introduction

Occasionally, prosthetic oddities present such problems that the fabrication of dentures becomes a real challenge, a challenge so intriguing that the issue at hand is obscured or lost. It must be borne in mind that a dental prosthesis serves a threefold purpose. It complements facial aesthetics; it is an adjunct to speech; and it is a major aid in mastication. Which of these purposes a prosthesis should serve, is best determined by a thorough evaluation of the patient's needs. A critically ill-patient, or one who is totally indifferent to aesthetic or speech values, obviously is not in need of these considerations. While the need for a masticating aid is important, it is contingent on the patient's ability to wear a prosthesis. The wearing of a prosthesis sometimes causes so many difficulties that its value is questionable.

Formidable prosthetic obstacles are most frequently encountered [1-3] where: (a) patients are so handicapped physically that they are unable to manage dentures; this class includes patients with any dysfunction of the muscles or accessory muscles of mastication, patients with xerostomia, and patients who have recently undergone a course of deep roentgen-ray therapy about the head or neck [4]; (b) the dentist is required to work under such adverse conditions that dentures cannot be constructed properly as is the case where a bed patient is confined to the home; (c) the patient's mental indifference does not warrant the construction of dentures. In these instances, the endeavour to affect a better nutritional balance by enabling the patient to ingest a more wholesome and a more varied diet is the prime physiologic issue. If the comminution of food material can be accomplished more easily by food choppers, liquefiers, mincers, etc., with less detriment to the patient, than by the patient's ability to manipulate dentures, then the construction of dentures is contraindicated. Dentures constructed under any of the aforementioned hazards represent a waste of time and effort on the part of the dentist, and a waste of time and money on the part of the patient. Since the dentist and the patient can ill-afford such extravagance, this situation is one of the few remaining thorns in the side of dentist-patient relations.

Aim of the Study

It is the purpose of this article to discuss some of the factors which enhance the problems encountered in denture construction, factors which may ordinarily be overlooked.

Theories

The first of these impacting factors is the saliva as it is related to mastication, particularly in the denture patient. Aside from cellular debris and the microorganisms usually found in the oral flora, the saliva is primarily made up of two physical components, a serous fraction, or wetting agent, and a mucous fraction, or lubricating agent. The serous fraction acts as a solvent and facilitates the breakdown of the food material during mastication, while the mucous fraction lubricates the bolus prior to deglutition. The parotid gland is characterised by a serous secretion, the sublingual gland by a mucous secretion, and the submaxillary gland by a mixed secretion [5].

Mastication may be divided into three phases: (A) the actual comminution of food material, (B) the moistening of the bolus, and (C) the lubrication of the bolus preparatory to deglutition. It should be remembered that the absence of teeth does not necessarily preclude the latter two phases of mastication, and that teeth are useful only for the comminution phases. Furthermore, by careful selection of soft nonfibrous foods, teeth are not essential for any phase of mastication; consequently, there are circumstances where the construction of dentures for the edentulous patient is ill-advised. The saliva, however, is not only essential for the moistening and lubricating phases of mastication, but is also necessary for the retention of dentures under normal conditions. Assuming that the denture base is an accurate negative of the tissues which comprise the basal seat, the denture base resists dislodging because of adhesion, peripheral seal, and traction.

Adhesion

Adhesion is the adherence or sticking together of dissimilar molecules; dentally speaking, it is the molecular attraction between the tissue surface of the denture base and the mucosa of the basal seat when both surfaces are wet with a thin film of saliva. This phenomenon is dependent upon two other factors, cohesion and surface tension of the saliva. Cohesion is the sticking together of like molecules, while surface tension is the resistance to rupture possessed by the surface film of a liquid. The saliva, therefore, should have the ability to wet both tissue and denture surfaces, to be expressed into a thin film without rupturing, and to have sufficient adhesion to attach the denture base to the mucosa. The degree of adhesion is a function of the film thickness; the thinner the film the greater the adhesion. The film thickness in turn is determined by the mucin (a family of high molecular weight, heavily glycosylated proteins produced by epithelial tissues in most animals) content of the saliva. A copious flow of thin serous saliva permits a thin salivary film, a thorough wetting of the denture base and the mucosa, and, hence, maximum adhesion, while a viscid, ropy (mucous) saliva cannot be expressed into a sufficiently thin film to provide adequate adhesion. The presence of excessive mucin beneath the denture base behaves much like food debris; it displaces tissue and therefore affects an elevation or rebound of the denture base from the mucosa.

Peripheral seal

Peripheral seal is a positive contact of the entire perimeter of the denture base to the yielding tissues outlining the basal seat. This seal is affected only when the entire periphery and the contacted tissues are wet with saliva, and because of the effectiveness of this seal, any dislodging force is resisted by atmospheric pressure.

Traction

Traction is the frictional resistance, the denture base exhibits to skidding over the tissues of the basal seat. It is due to the intimate apposition of the denture base to the minute contours of the tissues of the basal seat. Any thickening of the interposed salivary film by excessive mucin destroys the intimacy of the contacting surfaces, thereby reducing friction and facilitating skidding.

Since the saliva is so vitally concerned in mastication and in the retention of dentures, it is desirable to obtain some index of salivary function before denture construction is begun. The index used for this purpose is one based on the buffering potential of the saliva.

Preliminary report

Chemistry of saliva - controls

Under normal resting conditions, the pH of the mixed salivary secretions ranged from 5.7 to 7.0 [6]. However, not all components are secreted at the same pH. Again, under normal resting conditions, the parotid secretion varied between a pH of 5.5 to 6.5 [7], while the sublingual and submaxillary secretions combined were decidedly more alkaline, with a pH range of 7.0 to 7.5 (control: healthy objects; sample size (N) = 40; repeatability (n) = 5).

The mixture of all oral secretions imparts a buffering potential to the saliva that is quite unique [8]. Irritants which stimulate the taste buds initiate a reflex action which increases the flow of the salivary glands. Acids in particular elicit an immediate response. Not only is the salivary flow considerably increased, but also the hydrogen ion concentration is depressed as indicated by a rise in pH to a level of 7.5 to 8.0 (healthy objects; N = 40; n = 5); hence, acid foods are neutralised both by dilution and by buffering. The buffering action of the saliva is so proficient that during the mastication of an apple (pH 3.5 to 4.5) (healthy objects; N = 40; n = 5) the pulp-saliva mixture has become elevated to a pH of 7.5.

Chemistry of saliva - patients

The use of fruit as a salivary stimulant is not convenient, especially for edentulous patients, and for that reason an acid beverage is substituted. The method used to indicate the degree of salivary flow is simple and expedient. The pH of the resting saliva is recorded with nitrazine (phenaphthazine; $C_{16}H_{10}N_4O_{11}S_2$) paper. About 59.1-118.3 ml (2 to 4 ounces) of cola beverage (pH 2.46) are given to the patient (will be introduced later) to drink and the pH again recorded with nitrazine paper. The average pH of the normal resting saliva is about 6.3, while that of the saliva immediately after swallowing the cola beverage is about 7.5 to 8.0. Should the saliva fail to respond with a rise in pH, a lack of salivary secretion is evident; the rationale is that in order to have an abrupt rise in salivary pH there must be a transient hypersecretion of saliva with an elevated pH, while a lowering of the pH indicates a lack of salivary flow and buffering potential.

Any impairment of the salivary flow or buffering potential necessitates placing dentures over tissues that are in a constant state of mild irritation because of the hyperacidity of the environment. Occasionally, the evaluation of salivary flow will disclose xerostomia, in which case dentures are for the most part contraindicated because tissue tolerance is inadequate, retention is lacking, and solid foods cannot be moistened, lubricated, or swallowed unless the bolus is moistened constantly with a beverage. However, there are extenuating circumstances such as a patient's youth or the urgency for a cosmetic effect, which demand the construction of dentures. Such situations require heroic measures to keep the dentures wearable even for limited usage. The following case reports are submitted to demonstrate the problems encountered in prosthetic management where xerostomia exists.

Case Reports

Case 1: A.K. (white man; 59 years)

History: Chief complaints were ankle edema of four weeks' duration, dyspnoea, and inability to eat. The patient had been admitted to a hospital for the second time because of ankle swelling. He had been hospitalised two years previously for a heart ailment. There was no clear-cut history of rheumatic fever, although he was known to have had a heart murmur for at least ten years. About two years earlier, the patient had a cerebrovascular accident, resulting in a partial facial paralysis and loss of speech, and with a loss of sensation of the right arm and leg. The patient had lost a moderate amount of weight in the past two years and complained of an inability to eat with his present dentures. He had been edentulous for about fifteen years.

Physical examination: The patient was fairly well-developed but poorly nourished. There was a sensory involvement but no motor involvement of the right arm and leg; there was a residual partial aphasia. Other physical findings were negative with the exception of cardiac and pulmonary symptoms.

Oral examination: The patient was edentulous and wore ill-fitting dentures part of the time. The tongue and mucosa were deep red in colour, smooth, and severely dehydrated. It was difficult to find sufficient moisture in the mouth to record the pH of the saliva which was (4.5). The drinking of the cola beverage did not stimulate any salivary response as indicated by a drop in pH to 3.0. The nasal septum was deviated, and the nares were atrophied, resulting in frequent mouth breathing which further added to the oral dehydration.

Provisional diagnosis: (I) Chronic rheumatic carditis, valvulitis, mitral insufficiency, and aortic stenosis and insufficiency, decompensated. (II) Right pleural effusion. (III) Residuals of left cerebral thrombosis or embolus. (IV) Xerostomia, extreme dehydration, and edentulous without adequate replacements.

Prognosis: Medical prognosis was unfavourable because of progressing cardiac failure. The dental prognosis was equally poor because of the extreme dehydration of oral tissues, lack of tissue tone, and patient's physical inability to manage dentures.

Treatment: Dentures were constructed and inserted on Oct. 5, 2017 to provide more comfortable dentures bases, to maintain morale, and to retain facial aesthetics. However, the patient was unable to ingest anything other than liquids. Five drops of 2 per cent pilocarpine (is an orally available cholinergic agonist that is used to treat symptoms of dry mouth in patients with keratoconjunctivitis sicca (Sjogren syndrome*);* $C_{11}H_{16}N_2O_2$) solution were administered before meals, in the hope that salivation could be stimulated. This was ineffective and finally discontinued. A lemon-flavoured synthetic saliva was given the patient to sip whenever dryness of the mouth was noticed. This partially alleviated the dryness. Since it was not convenient to carry a bottle of saliva solution at all times, the patient continued to be distressed with dehydration and general soreness about the oral cavity, which persisted through the entire course of dental treatment. The patient developed a lobar pneumonia and died Dec. 25, 2018.

Case 2: H.B. (white woman; 57 years)

History: Chief complaints were canker sores about the mouth, swelling of the lips with fissuring, burning, scaling, and a drawing sensation. The patient stated that she began to develop lesions four months before, at which time a local internist was consulted. After preliminary laboratory studies, she prescribed high potency vitamins, crude liver extract, and B_{12}. There was no alleviation of symptoms in the following four months and the patient was hospitalised for a more complete physical and laboratory examination. A nutritional survey disclosed a diet that was well balanced and replete in whole grains, fresh fruits, and salad greens.

Physical examination: The patient was a middle-aged woman, well-developed and well-nourished, slightly obese, well-oriented, cooperative, intelligent, and in no acute distress. She had no physical deformities. The eyes showed slight conjunctival injection but were otherwise normal.

Oral examination: Fissuring of the lips with an acute cheilosis at the angles, moderate swelling, and evidence of desquamation was present. The buccal mucosa was reddened and injected with multiple aphthae about the mucolabial flexure. The tongue was thickened and reddened with papillae present. The entire oral cavity and lips were markedly dehydrated. The maxillary arch was complete with the exception of the third molars. The posterior teeth were badly discoloured and heavily restored. The anterior teeth were also badly discoloured; all had extensive silicate restorations, which were in a bad state of dissolution. The patient wore a lower partial denture supplying the anterior teeth, the left first molar, and the right first and second molars. Although the remaining lower teeth were badly discoloured and heavily restored, they responded to vitality tests. Roentgenograms disclosed no apical pathosis and no significant alveolar or periodontal breakdown.

Laboratory findings: The pH of the resting saliva was 4.5, and upon stimulation with the cola beverage it became 4.7, indicating very little buffering response. All other laboratory findings were negative or of no significance; neurologic tests were negative; there were no sensitivities to the usual allergens.

Diagnosis: (a) Xerostomia. (b) Acute cheilitis with edema, reddening, and desquamation. (c) Aphthous stomatitis. (d) Edema of the tongue, with fissuring and reddening. (e) Conjunctivitis.

Prognosis: The prognosis in general is good; however, it is doubtful whether the salivary and lachrymal glands will ever return to a normal function, but with the assistance of emollients and sialagogues, the mouth in general should be quite comfortable.

Treatment: The teeth were so heavily restored and so badly discoloured that the removal of the upper teeth might reasonably be considered; however, it was decided, because of the lowered oral pH, the dehydration of the oral tissues, and lack of tissue tone, that the construction and insertion of dentures would be too hazardous; it was also decided that keeping the teeth in a good state of repair would be the treatment of choice.

On alternate days the aphthae were treated directly with copper sulphate crystals, followed with a sodium bicarbonate rinse. After eight days of such treatment, the ulceration had healed. The lips were treated symptomatically by frequent applications of cold, wet dressing, immediately followed with 10 per cent boric acid in lanolin (is called wool wax or wool grease, is a wax secreted by the sebaceous glands of wool-bearing animals. Lanolin used by humans comes from domestic sheep breeds that are raised specifically for their wool.) to retain the moisture supplied by the wet dressings. The recovery was quite dramatic, requiring only five days. However, the labial fissuring and scaling were prone to recur upon the cessation of local treatment. The patient was advised to continue the wet dressings and emollient as needed.

To induce salivation, five drops of 2 per cent pilocarpine solution were given three times a day, before meals. The dosage was increased by one drop every eight days until eight drops were given, at which level the patient became more comfortable.

Stilbestrol (also known as 4,4'-dihydroxystilbene or 4,4'-stilbenediol, is a stilbenoid and the parent compound of a group of nonsteroidal estrogens that includes, most notably, diethylstilbestrol) was also given since xerostomia is frequently a sequel to menopause. With a slight increase in salivation, the local symptoms disappeared and the patient was placed under the surveillance of her local dentist.

One year later, the patient returned for a consultation. There was no evidence of increased activity of lachrymal or salivary glands since her last visit. The patient stated that she was still dependent on the pilocarpine solution and stilbestrol to remain symptom-free. The following formula was prescribed to stimulate the combined secretions of the parotid, the sublingual, and the submaxillary glands.

Citrocarbonate: 2.40

Mucin: 0.75

Urea: 0.05

Methyl cellulose: 1.20

Oil of lemon: 0.06

Aqua qs ad: 240

The methyl cellulose (a chemical compound derived from cellulose. It is sold under a variety of trade names and is used as a thickener and emulsifier in various food and cosmetic products, and also as a treatment of constipation. Like cellulose, it is not digestible, not toxic, and not an allergen; $C_6H_7O_2(OH)x(OCH_3)y$) was used to retain moisture in the mouth, along with oil of lemon if a flavouring is desired. This mixture provides a moistening, lubricating, and buffering effect during mastication.

The patient was instructed to dilute 2 to 4 tablespoonfuls with an equal volume of water and sip the mixture during mastication or as needed to maintain comfort.

Because of nutritional adequacy, the use of vitamin and mineral supplement was not warranted. The patient was instructed to continue home treatment and to return every four months for consultation.

Discussion

The development of sore mouths after the insertion of dentures for no readily apparent reason can be distressing and perplexing. Often there are no gross lesions, such as those encountered in the traumatic abrasion from an overextended border, but rather there is a general, vague, and fleeting tenderness, one that is never in the same area twice. The reasons given for such occurrences are many; there are idiosyncrasies in relation to the denture base material, occlusal prematurities, incorrect vertical dimension, etc., all plausible and valid explanations, yet without much thought given to the tissue tone and the function of the saliva.

The saliva is a formidable diluting agent; it is secreted at the rate of 1,000 c.c. to 1,500 c.c. daily. Although the average pH range of foods varies from 2.5 to 8.0, the saliva has the remarkable ability to buffer foods during mastication to the narrow pH range of 6.5 to 8.0. The saliva is never secreted at a pH as low as in Cases 1 and 2. However, the depressed pH is the direct result of the activities of acidogenic organisms found in the mouth. The acids formed by such organisms are easily diluted and neutralised by a normal saliva. When the salivary flow is substantially impaired, the buffering factor is largely eliminated and the oral pH is depressed, as seen in both cases. Aljerf of Damascus University has ably demonstrated that pH is a salient factor in the irritability of nerve endings, which become increasingly more sensitive as the pH is depressed. This phenomenon reasonably accounts for the hyperirritability of the oral tissues in the cases of A.K. and H.B. Furthermore, with the decrease of saliva the integrity of all irritated tissues is diminished, thus rendering such tissues more susceptible to infection, as was shown particularly, in Case 2.

When an excessively mucous saliva is encountered, a normal saline rinse can be used to cut and remove the mucin from the mucosa prior to the insertion of dentures. The tendency toward a ropy saliva is usually the result of dietary imbalance or inadequacy, the adjustment of which, together with a vitamin and mineral supplement, is often sufficient to affect a more normal salivary secretion [9].

Conclusions

1. It is prudent to evaluate the degree to which dentures can fulfil a patient's aesthetic, speech, and nutritional requirements, for occasionally aesthetic and speech factors are of minor importance. While nutritional problems are paramount, they can, when necessary, be surmounted by methods other than the construction of dentures. Where the danger of radiation necrosis is imminent, following a course of deep roentgen-ray therapy, or where any other circumstances contraindicate the construction or wearing of dentures, a balanced mechanically soft diet can be maintained by means of food choppers, food blenders, juicers, etc.

2. Noting the appearance of the oral tissues is of prime importance, since the integrity of the supporting tissues is directly related to tolerance and comfort in the wearing of dentures. Furthermore, when the state of the oral tissues is suggestive of a subnormal salivary function, it is discreet to ascertain the character of the saliva and degree of flow before the natural teeth are removed, where their removal is arbitrary and not a biologic necessity. Because the saliva is essential in the attachment of the denture base to the mucosa, the extraction of teeth for aesthetic reasons can be embarrassing and disconcerting if dentures cannot be worn comfortably because of impaired salivary function. The prosthodontist may well regard such signs as redness, swelling, dehydration, and depressed oral pH as hazards and should be cognisant of the fact that the construction of dentures is but a single step in the management of the edentulous patient where such a syndrome exists.
3. The recording of the resting and stimulated salivary pH is a simple and reliable index of salivary function.

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Conflict of Interest

The author declares no conflict of interest.

Bibliography

1. Aljerf L and AlHamwi B. "Up-to-date methods used in dental materials designs". *Mathews Journal of Dentistry* 3.1 (2018): 020.
2. Aljerf L and AlMasri N. "Educational study of the best Eco-Friendly applicatory dental restorative methods in using well-designed chemical composition of amalgam". *Acta Scientific Dental Sciences* 2.8 (2018): 113-120.
3. Aljerf L and Alshaarani F. "Green production of dental materials and the needs for a least-toxic dentistry". *Austin Journal of Dentistry* 6.1 (2019): 1126.
4. Long JH. "Occlusal adjustment as treatment for tenderness in the muscles of mastication in category 1 patients". *Journal of Prosthetic Dentistry* 67.4 (1992): 519-524.
5. Kim SK., *et al*. "The secretion processes in mucous and serous secretory cells of the rat sublingual gland". *Journal of Ultrastructure Research* 38.3-4 (1972): 371-389.
6. Aljerf L and Alhaffar I. "Salivary distinctiveness and modifications in males with Diabetes and Behçet's disease". *Biochemistry Research International* (2017): 9596202.
7. Aljerf L and Choukaife AE. "Parotid gland chemical secretion under identical and diverse forms of stimulation: major physiologic components". *Acta Scientific Dental Sciences* 3.6 (2019): 51-59.
8. Aljerf L and Mashlah A. "Characterization and validation of candidate reference methods for the determination of calcium and magnesium in biological fluids". *Microchemical Journal* 132 (2017): 411-421.

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