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Case Report

DUPLICATING PALATINE RUGAE IN COMPLETE DENTURE PROSTHESIS TO ENHANCE THE RELATIONSHIP BETWEEN FOOD AND TASTE RECEPTORS

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Abstract

Among the various anatomical landmarks of the oral cavity Palatine rugae are perhaps one of the least understood or unexplored regions of the oral mucous membrane. Due to this, they have been arbitrarily associated with functions like speech, adaptation, proprioception and taste. However the mere fact that they are one of the earliest developing parts of the oral cavity and persist throughout life with minor or no change should raise a doubt in anyone's mind. This article in the form of a clinical case report presents its role in enhancing tongues ability to taste sour food besides presenting a simple technique to duplicate the existing palatine rugae in complete denture prosthesis.

Key words: acquired taste, taste buds, flavors, denture, sour food.

Introduction

Characterizing complete denture prosthesis to fulfill patient expectation is an aspect of dental science that requires exploration beyond the limits of Prosthodontics. Advances in forensic dentistry like chelioscopy and rugoscopy have generated renewed interest in the significance of these soft tissue landmarks which were thought to hardly have any importance.[1,2] Palatal rugae, also called plicae palatinae transversae and rugae palatina, refer to the ridges on the anterior part of the palatal mucosa, each side of the median palatal raphe and behind the incisive papilla.[3,4] Palatine rugae are elevations of the mucous membrane and are very prominent in most of the animals where they help in gripping the food before tearing it with brute force.

In humans, however their role has been arbitrarily attributed to functions like mastication and swallowing, phonetics, suction and more recently forensic dentistry.[5-8] During earlier years, its role in phonetics was mainly stressed by Prosthodontists who were treating patients with complete denture prosthesis although no experimental evidence exists to support their consideration as a speech organ.[9-11] Prosthodontists however, have managed to prove that increase or decrease in the thickness of the denture in the region of Palatine rugae alters speech sounds.[12-15] Most of the studies done related to palatine

rugae in complete denture prosthodontics is associated with denture characterization which in turn is mainly done to enhance aesthetics. Research in food science at present has allowed us to have a better understanding of our ability to perceive different flavors. Interaction at molecular level between hydrogen ions and taste receptors to cause response to sour taste [16, 17] is the basis of this article which presents a novel technique of incorporating existing palatine rugae of patient into his complete denture prosthesis and its ability to enhance sour taste perception.

Case report

An elderly male patient, aged 52 years and working as a quality control inspector in an ice cream factory reported to the department of Prosthodontics with a chief complaint of loss of all natural teeth for one year. Medical history was noncontributory and dental history disclosed a loss of natural teeth due to mobility and decay. The sequence that the tooth loss occurred was mandibular and maxillary posteriors first while maxillary anteriors were last. Patients' expectations were related to his work that required him to taste various flavors made at the ice cream factory. The patient was not habituated to any tobacco or related products. Extra oral examination revealed a bilaterally symmetrical face with a decreased vertical dimension of the face in the lower third region. Intra oral examination showed well-formed maxillary and mandibular residual alveolar ridges with prominent palatine rugae and hard tissue undercuts in the maxillary labial area of the ridge **(Fig.1)**. The various treatment plan presented to the patient included implant supported fixed prosthesis, implant supported removable over dentures and conventional complete denture prosthesis. Definitive treatment plan included fabrication of two separate complete dentures with bilateral balanced occlusion, one was not characterized and the other was characterized with palatine rugae. An ideal protocol for complete denture fabrication was followed till the stage of denture processing. At this stage, a maxillary impression was made with irreversible hydrocolloid (CA 37; Cavex, Haarlem, Holland) **(Fig.2 A)**. Upon setting, half scoop of putty silicone elastomeric impression material (Reprosil, Dentsply/Caulk; Milford, DE, USA) was mixed with hand and adapted onto the palatal vault to duplicate the rug pattern that was outlined on the impression with an indelible pencil **(Fig 2 B)**. Once the putty over impression was ready, the denture processing step was commenced till the stage of trial closure. At this stage before removal of acrylic flash **(Fig 3 A)**, the putty over impression was fitted onto the dough to register rugae impression over the acrylic dough **(Fig 3 B)**. The flask was closed and the denture was processed using a long cycle. The denture was removed and regular laboratory remounting procedure and finishing / polishing was done. The denture was stored in water till the stage of denture insertion at which stage a clinical trial was done and the patient was given instructions regarding oral hygiene maintenance **(Fig 4)**. The second denture was prepared at the same time, which was non - characterized. At the stage of final insertion the patient was asked to wear and test both the dentures for being able to taste the flavors. Different flavored food items were tested by him. The patient was able to perceive the flavor better with the characterized denture. The patient was satisfied with the outcome of the prosthesis, especially with the range, incorporation which gave him a feeling of naturalness to the tongue.

Discussion

Palatine rugae develop as a result of discrepancy between the hard and soft tissues in the anterior region of the hard palate which results in soft tissue folds that

hang from the underlying bone. Evidence suggests that Palatinerugae form and pattern both are relatively prominent in human embryos, which towards the end of intrauterine life becomes less regular with the disappearance of posterior ones.[18] The palatine rugae are permanent and unique to each person and can establish identity through discrimination (via casts, tracings or digitized rugae patterns). Changes associated with the growth of the cranium especially the maxilla and eruption of teeth brings concomitant changes in the range pattern of the maxilla. Besides forensic application, the pattern is used for quantification of tooth migration in orthodontic treatment and has phonetic application in prosthetic rehabilitations. [19-21] Besides phonetics the authors believe that they may play important role in biological adaptation of the tongue to the denture and important contributor in taste perception.

Palatine rugae when duplicated on the denture improved patient's ability to identify flavors especially sour foods. Both response times as well as qualities of perception of sour taste improved with denture that was characterized with Palatinerugae. Understanding the perception of sour taste has received less attention than sweetness and bitterness, particularly for mammals. [16] Multiple mechanisms have been proposed to explain how hydrogen ions interact with taste receptor cells to cause a response. [22,23] Although it has been widely accepted that the hydrogen ion is the chemical entity responsible for the sour taste, many physiological studies have indicated the involvement of protonated organic acids as a stimulus for sour taste as well. Irrespective of the mechanism of for the sour taste of tongue, the patient was able to perceive the sour taste soon as well as better. The denture with palatine rugae provides an irregular surface against which the tongue is locked appropriately than with the flat surface. Once the tongue is locked in place a negative pressure is developed by it so that the flavor from the foodstuff is sucked. This is especially true for the sour taste. Another reason for better perception would be that when the tongue touches irregular surface of the palatine rugae, the elevations and depressions on the denture open up the microvilli by stretching them away from each other. This allows the hydrogen ion from food to come in contact with the taste receptor cells that are oriented perpendicular to the surface in a parallel arrangement.

Conclusion

Within the limit and scope of this study, it can be concluded that role of palatine rugae in the determination of the sour taste need to be investigated with further research. As for any complete denture prosthesis, the rugae should be always incorporated in the denture without increasing the thickness of the denture in that region.

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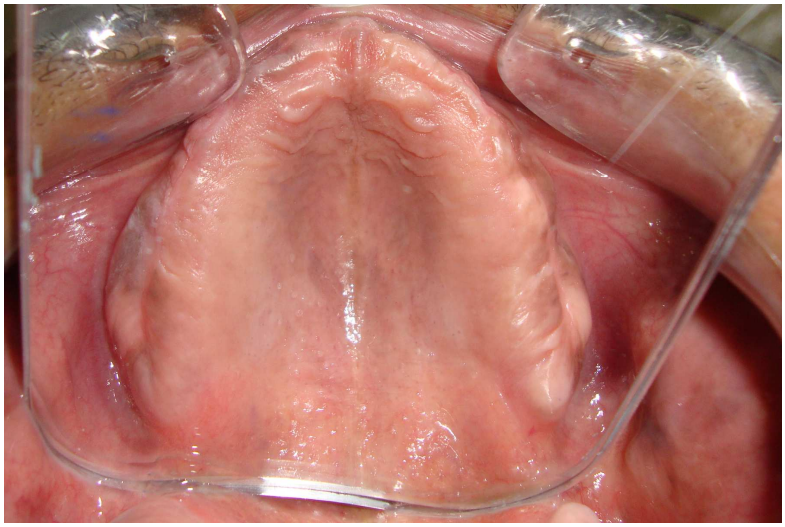

Figure 1: Intra oral view of the completely edentulous arch with prominent palatine rugae

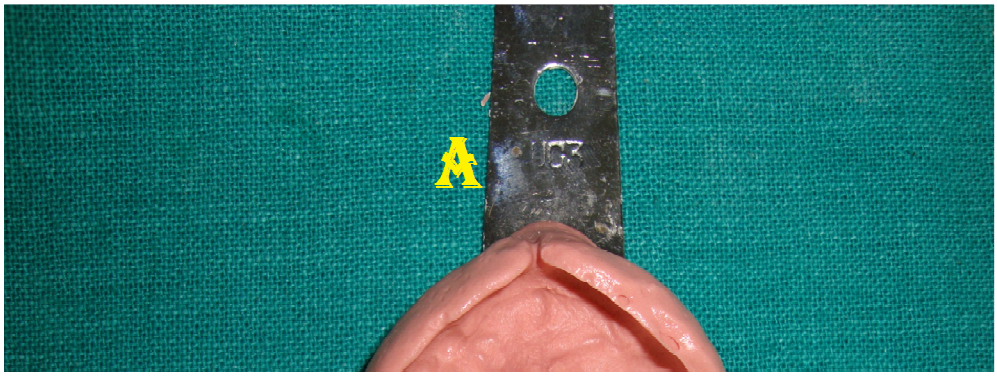

Figure 2: Alginate impression of the edentulous arch (A) and Putty over impression made over it

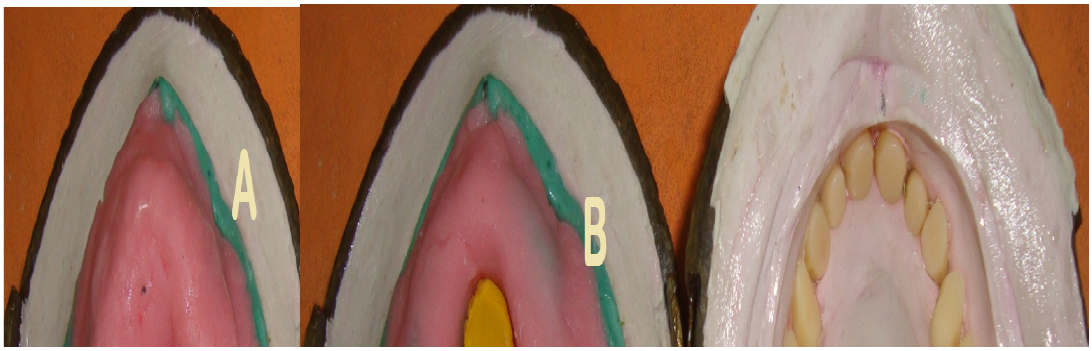

Figure 3: Trial closure procedure (A) showing Putty index used to imprint palatine rugae (B)

Figure 4: Processed denture showing patient existing palatine rugae pattern duplicated in the denture