THE DISTRIBUTION OF SENSORY SPOTS ON THE ORAL MUCOUS MEMBRANE

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Phonetic changes due to various dental prostheses have been investigated for several years in this laboratory. It was found that phonetic sufferings were chiefly induced by disturbances of the conduction of sensory nerve impulses on account of prosthetic materials, such as resin or metal plate, covering the mucous membrane. The distribution of the sensory spots over the mucous membrane seems therefore to be of great significance for considering the phonetic suffering.

Almost all the previous investigations on the sensory spots of the integument were made on the skin, and reports concerning the mucous membrane were extremely limited, so that they concerned with only one or two modalities of senses (Strughold (1)), or in general observations (Türkheim (2)) the distribution was not noticed. We therefore investigated the distribution of the sensory spots of pain, touch, cold, and warm over the oral mucous membrane with the purpose of getting a satisfactory basis for considering the above problem.

METHOD

10 subjects with a perfect set of teeth, good dentiform and normal oral membrane were used for experiments. Both negative and positive plaster models were first taken. At the beginning of each experiment, the oral cavity was washed with water and the saliva was wiped up by cotton wool. The sensory spots of each modality were examined by means of the instruments described below over the whole surface of the oral membrane. All the observed spots of each modality were marked with a colour pencil (Mitsubishi Ink Pencils) and a negative plaster mass of the upper or lower jaw, soaked in water, was placed on the mucous membrane and kept pressed for a while. Imprints of the sensory spots of four modalities on the negative plaster masses could separately be made in this way. The imprints on positive plaster models were obtained by repetition of the same procedures using negative masses.

The instruments used for stimulating sensory receptors were as follows: for stimulating the nerve endings for pain, Miller's dental broach mounted on a handle of resin was used. Precaution was taken not to approach the periosteum. The points of touch were examined with the Frey's stimulating hair. This examination often met with difficulties, as the estimation of the subject

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was readily disturbed by trifling moments such as noise, revetting the subject's attention upon something, etc. It was also difficult to discriminate between the senses of touch and pressure. For stimulating cold receptors, a special instrument was constructed. A copper tube, 9 mm. in diameter and 6 cm. in length, and covered with resin, was made. To the closed end of the tube a silver wire, 1 mm. in diameter and 2.5 cm. in length, was attached. Ice pieces were packed in the tube when used and the mucous membrane was touched with the tip of the wire. A heat nickelchrom wire (20 watt) was used for stimulating warm receptors. Its temperature was controlled by changing voltage (4-6 volt).

In all the examinations a stimulus, slightly stronger than the threshold, was generally used. Stimulations were given at regular intervals of 2-5 sec. When examinations were made on the buccolabial side, care was taken to avoid paralysis possibly caused by pressing the cheek.

RESULTS

Pain spots, (fig. 1): Among others the pain spots were most abundant in number. The density was less on the area of the mucous membrane along the gingival margin and on the interdental papillae, 26.8/cm.² On the projecting parts of the palatal rugae, the number was very few, and when these spots were stimulated, the subjects complained of a "thick or dull" pain in this area.

Fig. 1. Pain spots. A: Upper jaw. B: Lower jaw.
On the contrary, the hollow area of the rugae was provided with more numerous spots and a “sharp” pain was felt on stimulation. The soft palate and the buccogingival fornix could be regarded as the areas distributed most densely with the spots, 350 or more/cm\(^2\). Stimulation given on this area caused violent pain so that the subject reflexly retracted. On the buccolabial side of the upper and lower jaw, the density of pain spots had a tendency to decrease progressively as it goes to the posterior part.

Touch spots, (fig. 2): The distribution was most dense on the interdental papillae, 35/cm\(^2\). The areas in their order of density are: incisor (35/cm\(^2\)), canine (35/cm\(^2\)), bicuspid (25/cm\(^2\)) and molar parts (7/cm\(^2\)). For designing dental prostheses, it will be worthy to keep in mind that, generally speaking, the spots are present less densely on the highest part of palatal vault than on the anterior part of the hard palate.

Cold spots, (fig. 3): These spots were far fewer in number than the above. They were most dense on the anterior parts, 4.6/cm\(^2\). In the majority of subjects, only few spots could be found on the margin part of molar palatal side.

Warm spots, (fig. 4): Most of these spots were seen at the front of upper and lower jaw, 3.6/cm\(^2\). As can be seen from this figure this sense may be regarded as the sense provided with the fewest receptors. The threshold of stimulation for these spots varied considerably according to conditions of the
mucous membrane. Careful and repeated examinations were therefore necessary for determining the sites of all these spots with certainty.

**DISCUSSION**

In this paper, only four figures, each representing one sense, are given. As the results of investigations made on ten subjects well agreed with each other, the figures may be regarded as to show the features of distribution of receptors for each sense, which can be applied to most subjects. In the density of distribution, the pain receptors are the highest, followed by the touch receptors and the cold and warm receptors are decidedly lower compared with the above two, while the warm receptors are fewest in number. This order of density coincides with that of the skin. Among the results above described, it will especially be noted that the gingival margin and interdental papillae are provided with relatively few pain spots, but with a great number of touch spots.

Türkheim (2) made examinations on the anterior part of the oral mucous membrane only, but so far his results agreed with ours. This is also the case in Strughold's investigations (3) which were made only on the cold sense, and in Schriever's investigations being performed on the sense of pain. Generally
speaking, however, the descriptions of the previous investigations are not very precise.

SUMMARY

1) Precise methods for investigating sensory spots on the oral mucous membrane were described, and the results of investigations on the four modalities of sense were illustrated.

2) The senses in the order of density of their receptors are: pain, touch, cold and warm.

3) The receptors for all senses are present most densely on the anterior parts of the membrane.

4) The gingival margin and interdental papillae possess less pain spots and more touch spots.

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REFERENCES