

# Temperature variations around periodontal pathological lesions

A. Volchansky and P. Cleaton-Jones

MRC/University of the Witwatersrand, Dental Research Institute, Wits, 2050, RSA.

## SUMMARY

*The objective of this investigation was to measure the temperature of acute and chronic gingival lesions and adjacent oral mucosa. Using a precise digital thermometer, temperatures were measured at 10 sites across 12 acute and 18 chronic gingival lesions. The sublingual temperature was used to calculate a temperature differential in order to correct for variation between individuals and then a further correction was made to allow for position of the lesion in the mouth. For both types of lesion warmth increased towards the buccal sulcus. Mean values showed that acute lesions were warmer than the gingival crest while chronic lesions were generally cooler. The temperature variation was as much as 3 °C. Temperature measurement may become a useful diagnostic aid.*

## OPSOMMING

*Die doel van hierdie ondersoek was om die temperatuur van akute en chroniese gingivale letsels en aangrensende mondslymvlies te meet. Met behulp van 'n akkurate digitale termometer is temperature op 10 plekke met betrekking tot 12 akute en 18 chroniese letsels gemeet. Die sublinguale temperatuur is as maatstaf gebruik om 'n temperatuur-differensieël te bereken om vir variasies tussen individue voorsiening te maak, en 'n verdere korreksie is gemaak om vir die posisie van die letsel in die mond voorsiening te maak. In beide tipes letsel het warmte in die rigting van die bukkale sulkus toegeneem. Gemiddelde waardes het getoon dat akute letsels warmer was as die gingivale kruin terwyl chroniese letsels oor die algemeen koeler was. Dié wisseling was tot 3 °C. Meting van temperatuur mag 'n nuttige diagnostiese hulpmiddel word.*

Oral mucosal temperature has been shown to vary depending on the site of measurement. For example the mucosa adjacent to molar teeth is warmer than that alongside incisor teeth and mandibular mucosa is warmer than maxillary mucosa (Ng, Compton and Walker 1978, Mukherjee 1978, Holthuis and Chebib 1983, Volchansky *et al* 1985). Diurnal variation has also been shown in the temperature of oral mucosa but the time of mucosal temperature measurement is less important than choice of tooth, jaw, position around teeth and subject (Volchansky *et al*, 1985).

One of the cardinal signs of inflammation is warmth (Kissane 1985) yet there is a lack of information on oral mucosal temperature changes in relation to inflammation. This investigation was undertaken to measure the temperature of acute and chronic gingival inflammatory lesions, and adjacent oral mucosa.

## MATERIALS AND METHODS

Prior to beginning the investigation the protocol was approved by the Committee for Research on Human Subjects of the University of the Witwatersrand, and informed consent was obtained from all patients who participated in the study, which was carried out in a specialist periodontal practice. Inclusion criteria were that one of the two types of periodontal lesions chosen had to be present, the lesion must not be localized to the gingival margin (to enable measurement around it), the lesion must not extend alongside more than two teeth and that the patient had to agree to join the study.

The two lesions investigated were defined as follows:

- Acute: a painful, poorly localized inflammatory lesion present for less than 48 h
- Chronic: a painless, well-localized inflammatory lesion present for more than 48 h.

These definitions were based on the Glossary of Terms of the Journal of Periodontology (1977).

Thirty patients presenting for periodontal therapy over a four month period who satisfied the above criteria were selected for the study. They comprised 18 females and 12 males, ranging in age from 30 to 61 y. Twelve presented with acute lesions and 18 with chronic lesions.

The temperature measuring device was a Bailey Instruments digital thermometer with a 0,4 mm<sup>2</sup> measuring point. The thermometer was calibrated against a mercury-in-glass full immersion thermometer and found to be accurate to 0,05 °C. The reproducibility of measurement was defined by 10 repeated measurements at the same mucosal site on four subjects whose mouths were closed for 10 sec between measurements. The coefficients of variation for each subject ranged from 0,1-1,3 per cent.

In the definitive study the tip of the thermometer was placed on the site to be examined at right angles to the surface, and was kept in place until the digital recording had stabilized which was usually within 5 sec. In this fashion 10 temperature readings were made in an X shape across each lesion.

Five were made starting at the gingival margin on the mesial aspect of the adjacent tooth then moving towards the buccal sulcus. Five more were made beginning at the distal aspect of the tooth moving in the opposite direction to the first group of recordings. This is shown diagrammatically in Fig. 1. The measurement sites were spaced at approximately 2 mm intervals with the third recording site in the middle of the lesion.

In order to correct for variations in body core temperature between patients the sublingual temperature was measured for each person and from this the gingival temperatures were subtracted to obtain a temperature differential for each site. The mean of the temperature differentials at two equivalent sites across each lesion was calculated on the lines of measurement, for example,  $A_1 + B_1 =$  value at measuring point 1 (Fig. 1).

2

As a further correction, since there is a difference in temperature from anterior to posterior and between the maxilla and mandible, the 2nd, 3rd, 4th and 5th measurements across each lesion were subtracted from the first measurement across the same lesion so that comparison could be made between lesions, regardless of where in the mouth a lesion was seen.

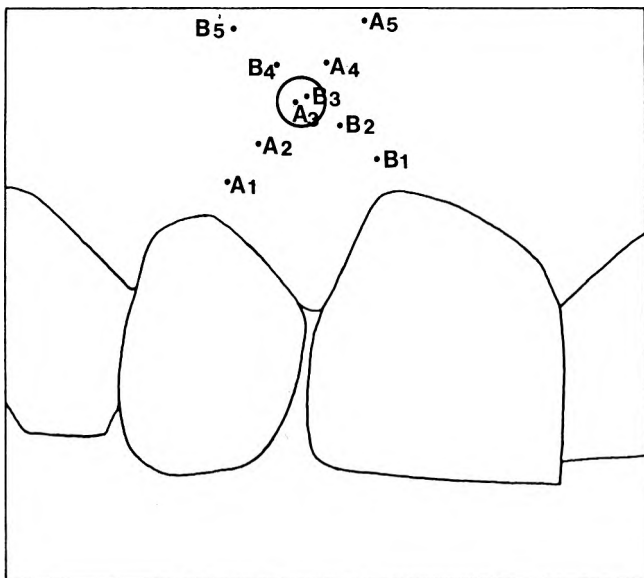


Fig. 1: Diagram to show the arrangement of measuring points across a gingival lesion.

**RESULTS**

The values for each measuring point within each individual were used in the subsequent analysis, and are shown in scattergram form in Figures 2 and 3. In these scattergrams gingival crest temperature differential (measurement 1) is shown as zero, and degrees of change in warmth or coolness at measurement points 2-5, are shown below or above the gingival crest zero value. Mean values are also shown for both acute and chronic lesions. In both types of lesion warmth increased towards the buccal sulcus. Mean values showed that acute lesions were warmer than the gingival crest while chronic lesions were generally cooler.

**DISCUSSION**

Acute and chronic inflammatory lesions of the periodontium are regularly diagnosed in clinical practice; definitions of acute and chronic are not generally used but rather duration of symptoms plus interpretation of clinical signs. In this study more precise methodology was used. The definition of an acute lesion in this study, namely one present for 48 h or less, painful and poorly localized is similar to that described in the Glossary of Terms — Journal of Periodontology (1977). In that, an acute abscess is one which has a relatively short course, producing some pain and local inflammation. Our definition of a chronic lesion, that is, one present for more than 48 h, no longer painful and well localized, is more precise than that in the Glossary of Terms which describes a chronic lesion as an abscess of long standing from which inflammatory symptoms have subsided.

In an acute inflammatory lesion there is vasodilation with a resultant increase in the flow of blood to an injured area, to thereby raise the temperature of the tissue. Histologically, according to Zegarelli *et al* (1978), in an acute periodontal abscess there is an increase in vascularity, the microvasculature at the site of injury becomes dilated and filled with blood, to produce hyperaemia and oedema. The increased warmth seen in the present investigation, over acute inflammatory lesions, confirms this phenomenon. Within the central area of each acute lesion examined there was as much as a 3 °C difference in temperature compared to the gingival crest. In a chronic inflammatory lesion, persistent irritation leads to a predominantly proliferative (fibroblastic) rather than an exudative reaction. This is a result of a “walling off” of the lesion. In our study we noted a generally cooler temperature compared to the gingival crest although considerable variation was seen from lesion to lesion.

Examination of the dental literature has not shown any similar study of inflammation and temperature around specific lesions so no comparison to previous work is possible. In the medical literature Lautenbach (1971) suggested that surface temperature measurement could be a useful diagnostic aid in the assessment of the progress of osteomyelitis. No details of objective measurements were described.

There are several clinical implications from this investigation. It is possible to measure temperature change, within small limits, precisely. Therefore when localization of mucosal inflammation is difficult, this form of temperature measurement may be an aid. Temperature measurement may be used to demarcate the area of a lesion. Also, a possibility exists that temperature change resulting from inflammation deeper than mucosa may be measurable. It may be likely that bony lesions not yet apparent on radiographs could be detected. More research in this direction is under way.

**ACKNOWLEDGEMENTS**

The authors are grateful for the assistance of Miss Janice van Wyk in the preparation of the graphs and to Mrs Hazel Ball for typing the manuscript.

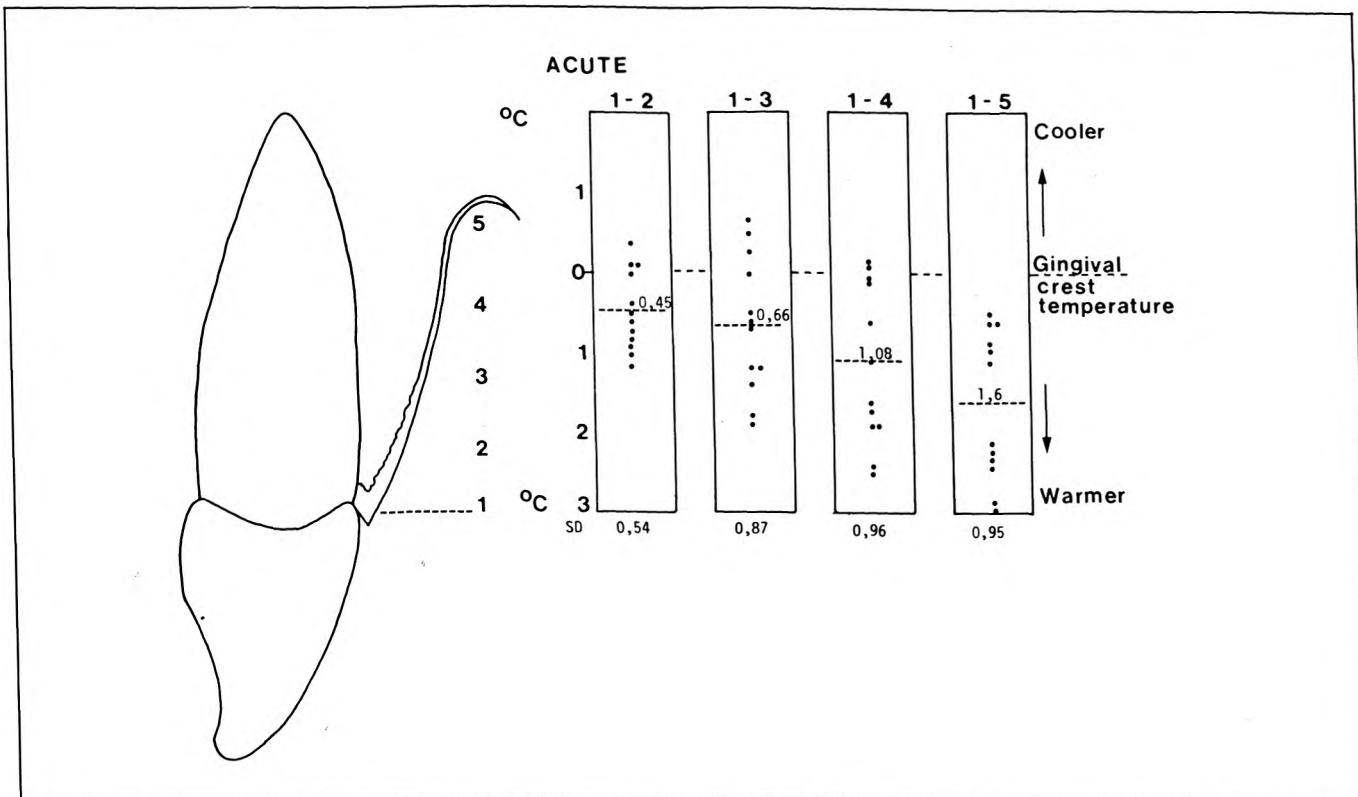


Fig. 2: Diagram to show measuring points levels 1-5 and a scattergram of temperature differentials for acute lesions.

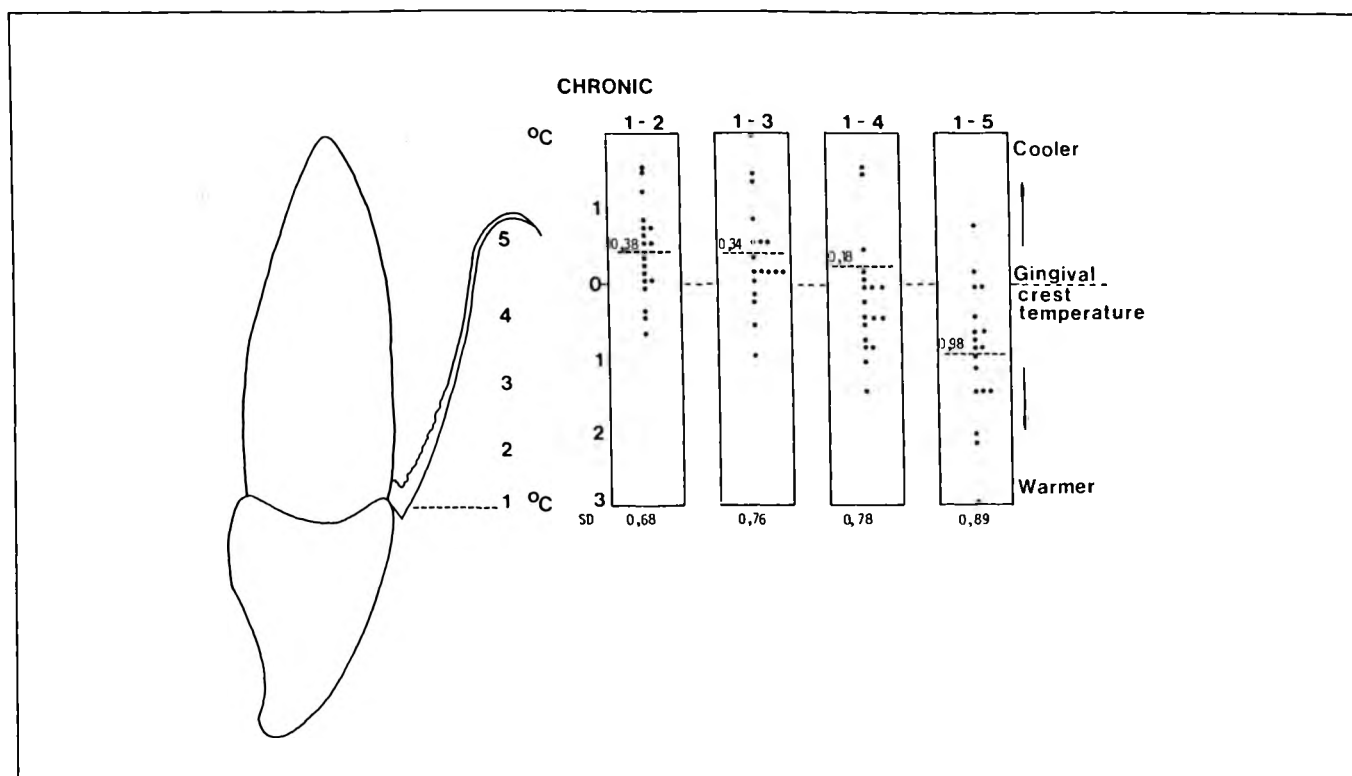


Fig. 3: Diagram to show measuring points levels 1-5 and a scattergram of temperature differentials for chronic lesions.

## REFERENCES

- Glossary of Terms. *Journal of Periodontology* (1977) p.1.
- Holthuis, A.F. & Chebib, F.S. (1983) Observations on temperature and temperature patterns of the gingiva. 1. Effects of arch, region and health. *Journal of Periodontology*, **52**, 187-189.
- Kissane, J.M. (1985) *Anderson's Pathology*, International Student Edition, 8th ed. p. 38. St. Louis: C.V. Mosby Co.
- Lautenbach, E.E.G. (1971) The assessment of progress in osteomyelitis. *South African Journal of Surgery*, **9**, 201-206.
- Mukherjee, S. (1978) The temperature of gingival sulci. *Journal of Periodontology*, **49**, 580-584.
- Ng, G.C., Compton, F.H. & Walker, T.W. (1978) Measurement of human gingival sulcus temperature. *Journal of Periodontal Research*, **13**, 295-303.
- Volchansky, A., Wright, P.G., Cleaton-Jones, P. & Fatti, L.P. (1985) Gingival and labial vestibular temperature in young individuals. *Journal of Dentistry*, **13**, 323-330.
- Volchansky, A., Cleaton-Jones, P. & Smith, M. (1986) Variation in oral mucosal temperatures. *Journal of Dental Research*, **64**, 781.
- Zegarelli, E.V., Kutscher, A.H. & Hyman, G.A. (1978) *Diagnosis of Diseases of the Mouth and Jaws*. 2nd ed. p. 107. Philadelphia: Lea and Febiger.