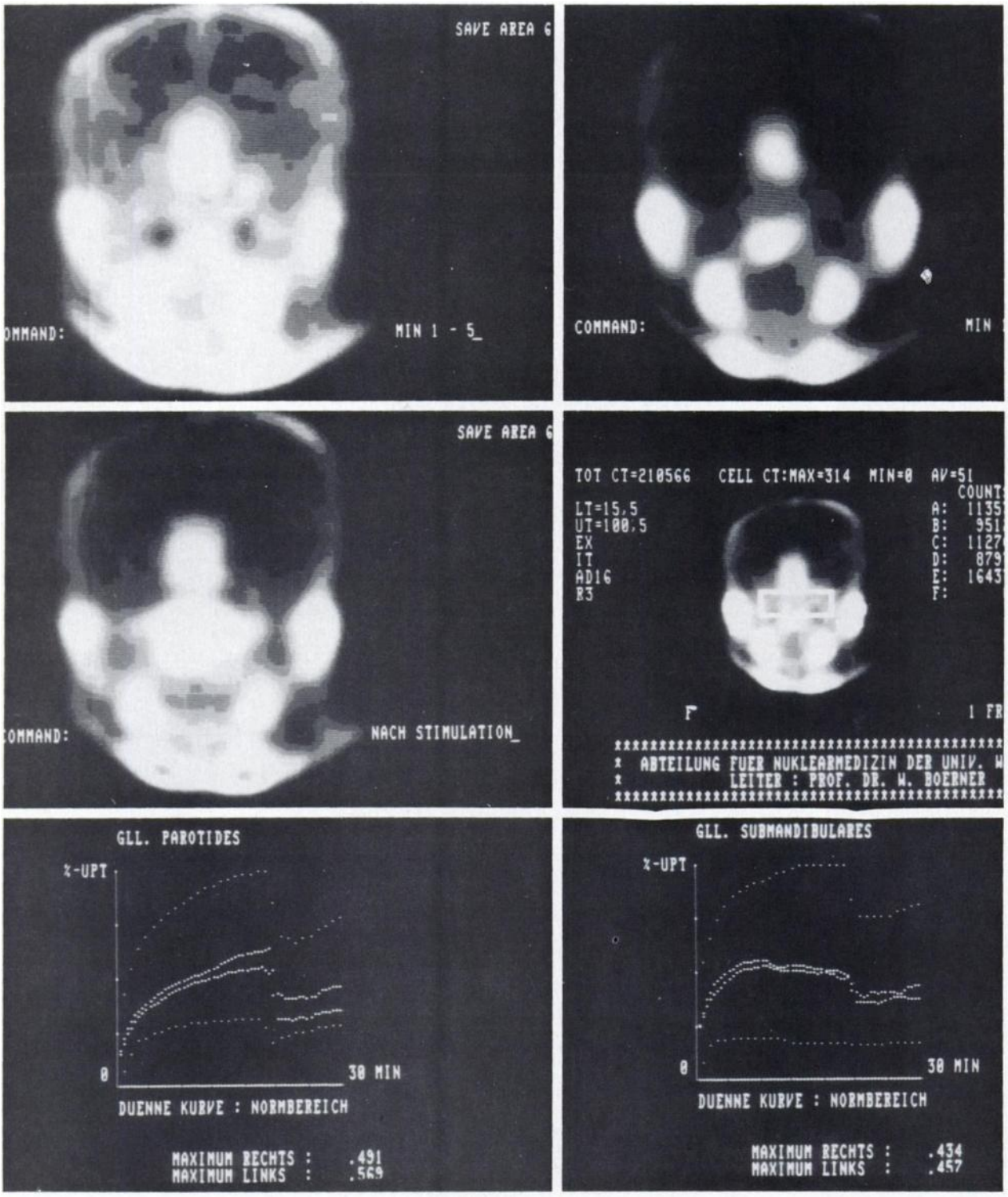

FIGURE 1
Normal salivary gland function with normal reaction to gustatory stimulation

Stimulated Salivary Clearance of Technetium-99m Pertechnetate

TO THE EDITOR: In a recent report, Blue and Jackson (*1*) recommended a stimulated salivary clearance of technetium-99m (^{99m}Tc) pertechnetate for separating normals and patients with known decreased salivary gland function (Sjögren's syndrome, patients following radiation therapy). They described their method using a one compartment model as easy to perform and independent of patient size, gastric and thyroid function. We do not agree with this assumption. In a multicompartment model for [^{99m}Tc]pertechnetate a clear-

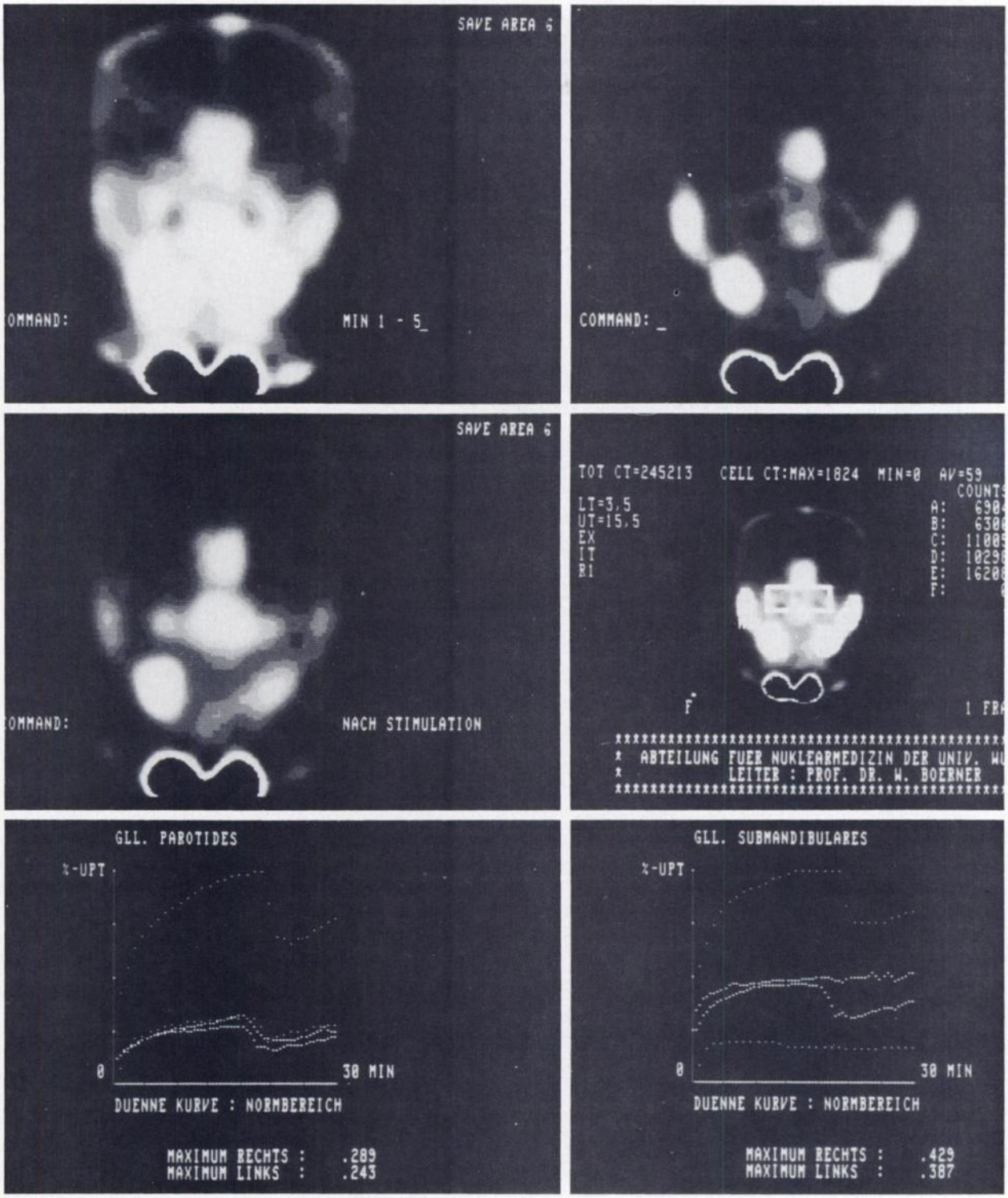

FIGURE 2
Reduced excretion of right submandibular gland

ance calculation for only one compartment (i.e., salivary glands) is not possible in the manner described.

Since inauguration of salivary gland scintigraphy in our laboratory in 1965 (*2*), we have routinely performed dynamic salivary gland imaging (*4*). Each patient is positioned anteriorly before a scintillation camera with the head extended. Following i.v. injection of 2 mCi (74 MBq) of [^{99m}Tc]pertechnetate, dynamic imaging over 30 min (one picture/min, 64 × 64 matrix) is carried out. Twenty minutes after injection, a gustatory stimulation is obtained using two drops of commercial lemon juice (Fig. 1). Functional scintigraphy allows evaluation of secretory and excretory parameters by registering

the flow curve of parotid and submandibular glands by region of interest technique before and after stimulation.

We believe our method (*3–5*) is easier to perform than the reported clearance technique (*1*) and that it allows a separation of normals and patients with salivary gland disorders (Fig. 2); not only in Sjögren's syndrome but also in other disorders, e.g., acute inflammations, chronic diseases and excretion disorders. We have also demonstrated the efficiency of our method for follow-up studies after therapy (*5,6*).

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REPLY: Becker's analysis of our study (*1*) is erroneous and further clarification is offered.

Clearance may be defined in the following way (*2*):

$$\text{cl(ml/min)} = \frac{\text{TEA}}{\int_{t_1}^{t_2} \text{Pdt}} = \frac{\text{TEA}}{\bar{p}\text{xT}}, \qquad (1)$$

where TEA = Total excreted activity;
Pdt = Plasma concentration over time;
p = Mean Plasma concentration during the time (T) of collection;
t_1 = Start of collection;
t_2 = End of collection; and
$t_2 - t_1$ = T.

Becker seems to imply that compartmental analysis is required to obtain the denominator $\int_{t_1}^{t_2}$ Pdt (=$\bar{p}$xT) of the clearance formula. This is not correct. In the case of a finite collection, such as 10 min of saliva, this factor, $\int_{t_1}^{t_2}$ Pdt, simply equals the area under the plasma activity curve during the time of collection ($t_1 \rightarrow t_2$). This area can alternately be represented as $\bar{p}$xT (Fig. 1). The shape of the plasma activity curve and thus the number of compartments that contribute to it is irrelevant. The curve is either integrated directly and the TEA/$\int_{t_1}^{t_2}$ Pdt clearance formula is used, or if the mean plasma concentration can be determined independently, the TEA/$\bar{p}$xT formula is used.

Compartment analysis is used in the clearance formula:

$$\text{cl(ml/min)} = \frac{\text{TEA}}{\int_0^\infty \text{Pdt}} = \frac{\text{Dose}}{\int_0^\infty \text{Pdt}} \text{ (by } \infty\text{, whole dose = TEA)} \qquad (2)$$

In this case, the curve cannot be integrated directly (to time infinity) and compartment analysis allows one to extrapolate the curve to infinity for subsequent mathmatical integration.

We studied ten patients in whom saliva collections were obtained with the heart positioned before a scintillation camera in order to derive a cardiac (≅ plasma) activity curve. Direct curve integration provided the same result as did the midpoint blood value (y = 1.00375, r = 0.999983) in the calculation of clearance. Therefore, we use the mid-point blood value for $\bar{p}$ as described in our article (*1*).

Finally, we explained in our discussion some of the pitfalls of semiquantitative (ROI) methods. Consider the following: Patient A has an effective volume of dose distribution twice that of Patient B. Both patients have the same clearance. Following the dose, Patient B will initially have a higher blood concentration, a higher excretion rate (mCi/min) and therefore a more rapid elimination of tracer. Patient A with an expanded volume of distribution will have a lower initial blood concentration, lower excretion rate and, therefore, a slower tracer elimination. The momentary concentration of tracer in the glands is dependent on the dose, the plasma concentration, the clearance rate, and the salivary transit time. Although the two patients' salivary function is the same, the curves for the two patients would be grossly different (Fig. 2).

Without elaborating in detail, it is obvious that other organs that compete with the salivary glands for pertechnetate uptake will alter the plasma concentration and thus the salivary concentration of tracer. Thus, a Graves' disease patient may reduce the available tracer so rapidly that the salivary uptake is minimal. The clearance will not be affected except as Graves' disease affects the clearance itself.

All of these considerations apply similarly to renal scintigraphy and to glomerular filtration rate (GFR) and ERPF determination methods and have been addressed recently by Jackson et al. (*2*).

Salivary scintigraphy is best evaluated by all modalities available including visual inspection of scintigrams, use of semiquantitative aids such as region of interest-grams and finally clearance measurements. To dismiss salivary clearance in favor of a qualitative curve is as to dismiss the GFR and ERPF in favor of diethylenetriaminepentaacetic acid and hippurate renography. All are useful and helpful in the right hands.