<ORIGINAL ARTICLE>Characteristics of Dental X-ray Films : Characteristic Curve

[Original]

Characteristics of Dental X-ray Films

— Characteristic Curve —

Hideaki TAKANO and Masayuki KANEKO

Department of Dental Radiology, School of Dentistry, HIGASHI-NIPPON-GAKUEN UNIVERSITY

(Chief : Prof. Masayuki KANEKO)

Abstract

The characteristic curves obtained from two types of the Kodak Ultraspeed dental X-ray films and two types of the Kodak Ektaspeed dental X-ray films were drawn by means of time scaling method. The Ektaspeed group showed almost the same curves at each observed tube voltage, but those of the Ultraspeed group were different from one another. It was expected that the origin of this difference might be caused by the differences of the film base and/or emulsion of each film.

Key Wards : Dental X-ray film, characteristic curve

Introduction

Since the Kodak Ektaspeed dental X-ray film was introduced in 1981, some technical studies have been carried out about the comparison between the Ultraspeed dental X-ray films and the Ektaspeed dental X-ray films for periapical radiography (for simplicity these films are called "ULTRA dental" and "EKTA dental" respectively).[1,2] Only a few reports, however, are available that run a comparison between the various kinds of the Kodak Ultraspeed dental X-ray films and Ektaspeed dental X-ray films collectively. This paper reports on the characteristic curves of four types of the Kodak X-ray films, i.e. the curves of ULTRA dental and EKTA dental, and those of the Ultraspeed dental X-ray films and Ektaspeed dental X-ray films for intraoral source panoramic radiography (for simplicity these two are called "ULTRA panagraphy" and "EKTA panagraphy" respectively).

The characteristic curves were drawn by means of time scaling method.[3] Observed tube voltages were 40kVp, 60kVp, 80kVp and 100kVp.

The characteristic curves of EKTA dental were highly similar to that of EKTA panagraphy at each observed tube voltage. But the curves of ULTRA dental were different

from those of ULTRA panagraphy. The latter was shifted from the low exposure range of the former to high. It is expected that the origin of this difference might be caused by the differences of film bases and/or emulsions of ULTRA dental and ULTRA panagraphy.

Experimental Method

The instruments used in the present study included an X-ray equipment (Soken SOFRON BST-1505CX), an automatic dental processor (Dürr Dental AC 245) and a micro-photometer (Union Optical MPM-122). Exposure conditions were as follows;

Tube voltages : 40kVp, 60kVp, 80kVp and 100kVp
Tube current : 1mA
FFD : 700mm

These films were exposed to X-rays through a lead slit, and the exposure time was varied.

The Kodak RP X-Omat Chemicals were used as a developer and a fixer. Developing conditions were as designated by Eastman Kodak Co. Ltd., in which the developing temperature was 27℃ and the cycle of the automated dental processor was 5 min/process.

The characteristic curves were drawn by means of time scaling method.

Results and Discussions

The characteristic curves obtained at 40kVp, 60kVp, 80kVp and 100kVp were shown in Fig. 1. The physical values obtained from these figures, i.e. the film gamma, the average gradient and the relative sensitivity, were shown in Table 1, Table 2 and Table 3 respectively.

In these figures, the shape differences of the characteristic curves obtained from each film type could hardly be seen at different tube voltages. Furthermore, the chara cteristic curves of EKTA detal and EKTA panagraphy were almost the same. Probably the slight difference seen may be attributed to observational errors. On the other hand the curves of ULTRA dental were different from those of ULTRA panagraphy over the entire range of tube voltage. These results obtained seem to suggest that the film bases and/or emulsions of ULTRA dental were different from those of ULTRA panagraphy. A film base of the former was very smooth and glossy to the naked eyes. One of the latter appeared to be the same optically as the former, but its surface was not glossy compared to the former. Such differences of the film bases and/or emulsions might cause the difference of the characteristics in the high density regions. Consequently, it is expected that the differences of the characteristic curves were due to the differences of either film bases and/or emulsions.

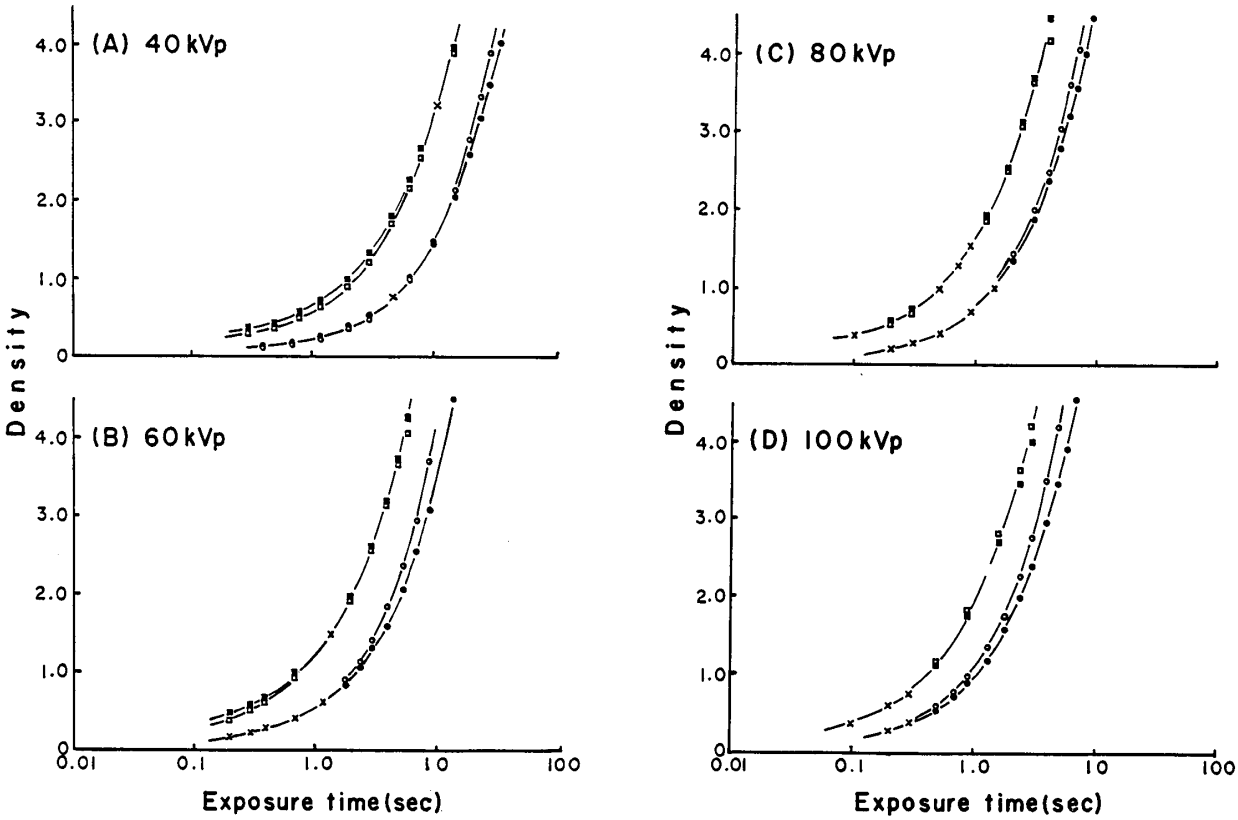

Fig. 1 Characteristic curves at 40kVp (A), 60kVp (B), 80kVp (C) and 100kVp (D). Each index means the observed density as follows ;
○ ; ULTRA dental
● ; ULTRA panagraphy
□ ; EKTA dental
■ ; EKTA panagraphy
And the cross index (X) indicates that the density of "dental" is the same value as that of "panagraphy".

The gamma of the Ultraspeed group are larger than those of the Ektaspeed group. And, according to Table 2, the Ultraspeed group had an average gradient larger than the Ektaspeedgroup. The gamma was almost determined in the range of density 2.0 and 4.0. On the other hand, the average gradient, which is a gradient of a straight line between density 0.25 and 2.0, was determined in the lower density region. In the clinical application, the film density region between 0.2 and 2.3 is very important. So it is expected that the Ultraspeed group films have a better contrast than the Ektaspeed group, when they were taken at appropriate conditions. This also means that the Ektaspeed group has a wide latitude.

It is said that the Ektaspeed dental X-ray film is twice as fast compared to the Ultraspeed dental X-ray film. But, as shown in Table 3, the Ektaspeed group was more than twice faster compared to the Ultraspeed group. Furthermore, ULTRA dental is somewhat faster than ULTRA panagraphy, although both of them belong to the Ultraspeed group.

Table 1 Gamma, which is the slope of the straight line portion of the characteristic curves.

tube voltages / fiim types	40kVp	60kVp	80kVp	100kVp
ULTRA dental	6.03	5.30	6.06	5.96
ULTRA panagraphy	5.00	5.34	4.86	4.88
EKTA dental	4.52	4.50	4.64	4.36
EKTA panagraphy	4.52	4.50	4.64	4.36

Table 2 Average gradient, which is the slope of the straight line between density 0.25 and 2.00. Two blanks were caused by difficult extrapolation.

tube voltages / film types	40kVp	60kVp	80kVp	100kVp
ULTRA dental	1.57	1.57	1.63	1.63
ULTRA panagraphy	1.57	1.47	1.58	1.52
EKTA dental	1.34	1.30	1.34	1.32
EKTA panagraphy	—	—	1.34	1.32

Table 3 Relative sensitivity, which were determined by the ratio of doses between "ULTRA" and "EKTA" with the density D=1.50.

tube voltages / film types	40kVp	60kVp	80kVp	100kVp
dental	2.58	2.29	2.50	1.96
panagraphy	2.87	2.64	2.62	2.30

Conclusion

1) The shape differences of the characteristic curves obtained from each film type at different tube voltages were hardly seen. Thus, a curve of any film type and any tube voltage falls on the same film type and any observed tube voltage by means of pararell movement.

2) The Ektaspeed group showed the same curves at most parts of any observed tube vol tage, because the Ektaspeed group consisted of the same film base and the same emulsion.

3) The characteristic curves of ULTRA dental were different from those of ULTRA panagraphy. It was expected that the origin of this difference might be caused by the differences in film bases and/or emulsions. The fiim base of ULTRA dental was similar to that of the Ektaspeed film.

4) The gamma and average gradient of the Ultraspeed group were larger than the Ektaspeed group. This means that the Ultraspeed group films, which were taken at appropriate conditions, have a better contrast than the Ektaspeed group. And also it seems that the Ektaspeed group has a wider latitude.

5) The Ektaspeed group was more than twice as fast compared to the Ultraspeed group. Furthermore, ULTRA dental was somewhat faster than ULTRA panagraphy, although both of them belong to the Ultraspeed group.

Acknowlegement

The authors wish to express their thanks to Mr. Takahiro Wajima (Higashi-Nippon-Gakuen University Dental Hospital) for his valuable advices.

References

1. Yosue, T., Yamazaki, Y., Maeno, Y., Matsumoto, H., and Furumoto, K. : On the characteristics of fast speed dental X-ray films, Shikahoshasen. 22(3) ; 223—227, 1982 (in Japanese)
2. Hidaka, K., Toyofuku, F., Araki, K., Konishi, K., and Kanda, S., : Radiological characteristics of dental films —on the energy dependence of the film speed—, Shikahoshasen. 22(4) ; 345—347, 1983 (in Japanese)
3. Tanaka, H., Saito, I., Yamamoto, C., and Yamada, K. : Experimental Textbook for Medical Radiology — general part—, 258—261, Kyoritsu, Tokyo, 1982 (in Japanese).

歯科用X線フイルムの特性

— 特性曲線 —

高野　英明，金子　昌幸

東日本学園大学歯学部歯科放射線学講座

（主任：金子昌幸　教授）

抄　録

Kodak社製のUltraspeed歯科用X線フイルム2種類とEktaspeed歯科用X線フイルム2種類について，それぞれの特性曲線をtime scaling法により描いた。結果としては，Ektaspeedグループの特性曲線は，各測定管電圧においてほぼ同一の曲線を示したが，Ultraspeed グループの特性曲線は異っていた。この違いの原因は，各フイルムのフイルムベースもしくは乳剤，あるいはその両方の違いにあることが想像された。

受付：昭和59年9月30日