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TECHNICAL NOTE

Using the ''STEP Test'' to evaluate processing speed in Moroccan hospitals

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Abstract The STEP Test is a simple method that can be used to quickly evaluate processing speed of automatic processors. It allows the identification of large deviations (>20%) in the processor-chemicals-film system. STEP means *Sensitometric Test for the Evaluation of Processing*. The performance of the processors taking part in the survey are calculated and compared to a standard processor where the film is processed under ideal conditions, according to manufacturer's recommendations. For each processor, in the dark room, a film is exposed to a sensitometer light, processed and the sensitometric curve is obtained. This survey was performed in 8 Moroccan hospitals in the cities of Casablanca and Rabat and included 11 processors. It was concluded that 50% of the processors present processing problems and are functioning under inadequate conditions since they present deviations larger than 20%.

Introduction

The evaluation of processing conditions is of major importance in radiology departments. Deficient processing is reflected in a low quality radiographic image and can be the cause of artefacts and loss of contrast, consequently reducing the chances of identifying details in the image. The abbreviation STEP means **S**ensitometric **T**est for the **E**valuation of **P**rocessing and is an empirical method [1—3] used to evaluate only the processing speed of automatic processors. This is a fast and simple method that allows the identification of processors working under very deficient conditions with deviations greater than 20% as compared to an ideal processor. The ideal processor that we called ''standard'' is the processor that functions exactly according to manufacture's conditions. In a previously published paper in Brazil [4], it has been showed that out of 18 processors evaluated in 8 hospitals, 33% were working outside limits and had to be repaired. In this work the dry-to-dry processing time was also recorded for the eleven processors as well as the chemicals' temperatures.

Methodology

The evaluation was performed in 8 Moroccan hospitals and involved 11 automatic processors. All the hospitals that took part in this evaluation belong to the university hospitals

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whose directors have authorized this research work. The hospitals will be named randomly as A, B, C, D, E, F, G and H.

The films used in this survey were provided by Matrix, speed 400 and are from the same box to eliminate any possible fluctuations in emulsion composition that could interfere in the final optical density. In each hospital, and for every processor, a film was irradiated inside the dark room, with the sensitometer light (Nuclear Associates model 07—417) and immediately processed to avoid image fading. A 21 step strip was generated and the optical density of each step is read by a densitometer (Nuclear Associates model 07—443). The sensitometric or characteristic curve can then be constructed.

The standard or reference speed (Sr) is chosen for a processor where the processing conditions are ideal, i.e. the chemicals-film-processor are from the same manufacturer and the processing conditions are adequate (processor cleanliness, chemical's temperatures, replenishment rates, dry-to-dry processing speed, etc…). For this processor an empirical processing speed of 100 was assigned. The films were exposed twice and the mean value of the optical density was calculated.

The processing speed is calculated according to the following relation:

$$PS = 10^{(S_r - S_o)\times 0.15} \times 100$$

Where:

- PS is Processing Speed;
- S_r and S_o are the sensitometer step numbers corresponding to the speed density for the standard reference sensitometer and the observed processors.
- 0.15 is the log of the relative exposure corresponding to the optical difference between the steps;
- 100: normalisation factor of processing speed.

The S_r and S_o values are taken from the characteristic curve and are obtained from the step speed 1 above base + fog. This procedure allows the determination of processing speed S_o, as compared to reference speed S_r.

Fig. 1 shows the characteristic curve relating the optical density to the sensitometric step, relative exposure and log of relative exposure. F + B represents base plus fog.

Results and discussion

As explained previously, the speed 100 represents the standard. Therefore, any value above 100 means over-development and below 100 means under-development. A 20% variation is acceptable, however, results outside these limits indicate that the processor is improper for use and must be repaired. For the films used in this study (Matrix 400, 24—18, emission in green), a 2.2 °C temperature difference corresponds to a 20% speed change.

The STEP Test was applied to 11 processors and one was assigned as the standard, therefore 10 were evaluated. The ''standard processor'' is the standard reference processor which performs according to the film manufacturer's recommendation. The results are presented in Table 1. It can be seen that 50% present under-development and 50% are working within the limits, i.e. from 80 to 120. The

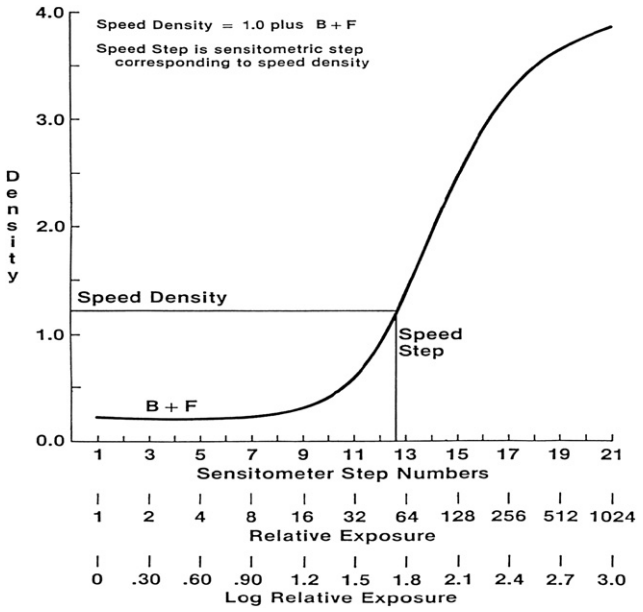

Figure 1 Characteristic curve relating density versus sensitometer step numbers, relative exposure, and log relative exposure.

processors which need to be repaired have their values displayed in bold. Hospitals A, B and C have two processors each and the others just one each.

Fig. 2 shows the characteristic curves for the 11 processors surveyed. Processor number 8 was chosen as the standard since it operates under ideal conditions.

The dry-to-dry processing time as the developer immersion time are presented in Table 2. These values were obtained by means of a stop watch.

During the first time this work was performed, the immersion time was not measured. However, when we returned to the hospitals to measure the immersion time and complete the data collection, some of the processors were broken. Therefore, it was not possible to measure the immersion time for all the processors. Also, one processor from hospital C did not run if the lid was kept open to perform this measurement. It could be observed that the immersion time vary a lot ranging from 19 to 26 s.

Developer immersion time is a constant for a specific processor model, but it may vary among different processor

Table 1 STEP Test results for the 11 processors.

Hospital	Processor manufacturer	Speed
A	Kodak	**77**
A	Kodak	90
B	Kodak	81
B	Kodak	**78**
C	Kodak	86
C	Kodak	85
D	Kodak	**79**
E	Kodak	100
F	Agfa	**74**
G	Kodak	82
H	Kodak	**74**