مراقبة جودة معالجة الأفلام في التصوير الطبي بالأشعة السينية

أ. أسماء سعيد أبوعجيلة المهدي – كلية العلوم العجيلات – جامعة الزاوية

الملخص :

يعد التحسين في التصوير الطبي بالأشعة السينية لتقليل جُـــرعات المريض أثناء فحوصات الأشعة السينية التشخيصية عملية مهمة جدا ، و- أيضا - معقدة بعض الشيء نظرا للمستوى العالي من جودة الصورة المطلوبة ، وعندما يتم تنفيذ أنظمة الجودة كأساس للتحسين ، يجب الانتباه إلي مؤهلات الموظفين ومراقبة جودة المعدات وإجراءات التصوير بالأشعة السينية ، فضلا عن الأساليب المستخدمة لتقييم جودة هذه الإجراءات ، وقد اقتصرت إجراءات مراقبة الجودة في مؤسسات الرعاية الصحية علي اختبار وحدات الأشعة السينية والأفلام ، ونظرا ؛ لأن معالجة الأفلام هي أحد أهـــمّ العوامل التي تؤثر على جُـــرعات المرضى وجودة الصورة أثناء فحوصات الأشعة السينية , فأي فساد في المعالجة سيؤثر علي جـــودة الصورة لذلك من المهم القيام بمراقبة المعالجة إما باستخدام المقياس الحساس أو تدرج الألمونيوم ، ولمنع الجرعـــة غير الضرورية للمريض الخاضع لإجراء التشخيص .

فتبحث هذه الدراسة العملية مراقبة جودة معالجة الأفلام في التصوير الطبي بالأشعة السينية بتقنيات محددة, وتقييم الفيلم المعالج الذي تم عرضه بدقة عن طريق :

1- تعريض الفيلم بمقياس حساسية X-Rite sensitometer ، واستخدام وجهين من الفيلم, ومن ثم تعريض الوجهين(الجانبين) الآخرين للفيلم لـــ: RMI sensitometer, والآن نقوم بتطوير الفيلم عن طريق المعالج الأوتوماتيكي. ونكرر نفس الخطوات بالنسبة للمعالج اليدوي ، ومن ثم قياس الأفلام المطورة للكثافة الضوئية (OD) باستخدام مقياس الكثافة ورسم النتائج البيانية لبرنامج ضمان الجودة الفعال. والتي منها وجدنا أن سرعة الفيلم باستخدام المعالج التلقائي أسرع من المعالج اليدوي. كما وجد أن المعالج اليدوي يحتوي علي مادة كيميائية معالجة ضعيفة ولهذا السبب تكون السرعة بطيئة ولديها كثافة قصوى اقل مقارنة بالمعالج التلقائي, لذلك اتجهت المؤسسات الصحية إلي استخدام المعالج الأوتوماتيكي بدلا عن المعالج اليدوي.

.2- أو عن طريق استخدام تدرج الألومونيوم المكون من 11 خطوة ذات درجة عالية من النقاء ومصمم لتوفير exposure إضافي لفيلم الأشعة السينية عن طريق زيادة

سماكة الألومونيوم في كل خطوة وأيضا من أجل exposure معروف، ومن النتائج قمنا برسم الكثافات كدالة ل exposure مع سماكة مجموعة الألومونيوم ، والتي يتم تمثيلها في منحني حيت وجدنا أن الكثافة مقابل سماكة منحنى الألومونيوم تتشابه في الشكل مع المنحنى المميز لمجموعة فيلم الشاشة. ويعتمد منحدر منحنى الكثافة مقابل السمك علي عامل exposure المستخدم في التصوير الإشعاعي لخط الألومونيوم المتدرج ، فنلاحظ من النتائج البيانية أن exposure يتناسب عكسيا مع سماكة تدرج الألومونيوم وكلما زادت الكثافة فان جزءا منx-ray تخترق الألومونيوم ، ويجب تعديلها للحصول علي صورة شعاعيه جيدة مع exposure صغير. ووجدنا أن ثلاث مناطق دائرية لها كثافة بصرية (optical density) تبلغ 0.5 و 1.0 و2.0 فوق المنطقة unexposed area على الفيلم .

3- وأيضا باستخدام ثلاث خطوات من كثافات معالجات RMI للتحكم في نموذج مقياس الحساسية (201 B) باستخدام مصراع ميكانيكي دقيق ومصدر ضوء لإعطاء تعرض ضوئي قابل للتكرار لثلاث مناطق دائرية علي فيلم ، وتم تسجيل الكثافات المقاسة ورسم النتائج البيانية لضمان جودة فعالة للبرنامج ، من هذه النقاط الثلاثة يمكننا الحصول على سرعة الفيلم ومتوسط التدرج. ومنها وجد أن سرعة الفيلم = 1.435(أوتوماتيكيا)=1.02(يدويا).

متوسط التدرج=0.828 (أوتوماتيكيا)=0.575 (يدويا).

base + fog = 0.21 (أوتوماتيكيا)=0.22(يدويا) فهي أقل من القيمة 0.25 وهذا يعني لا يتسرب ضوء كبير في الغرفة المظلمة ولكنه لا يشمل الضوء الأمن ؛ لأنه في هذه التجربة تم إطفاء الضوء الآمن بسبب ارتفاع الضباب المؤثر علي الفيلم.

بعد إجـــراء هذه التجربة والتي كان تركيزنا فيها علي مراقبة جودة معالجة الفيلم وهي خطوات مهمة للغاية لفحص الفيلم ما إذا كان في حالة جيدة ؛ لأن العديد من العوامل قد تؤثر علي جودة الفيلم مثل التخزين السيئ أو تاريخ الفيلم المنتهي الصلاحية لذلك يجب أن يقوم المصور الإشعاعي بإجراء العملية في ظروف فيلم جيدة ، وللحصول علي صورة واضحة مع تعرض إشعاعي منخفض للمريض. ونظرا ؛ لأن تشغيل المعالج يمكن أن يتغير في فترة زمنية قصيرة , فيجب فحصه يوميا، والمعالج الأوتوماتيكي أسرع وأفضل ، فيفضل استخدامه لمعالجة الصورة بدلا من المعالج اليدوي لمعالجة الأفلام أثناء تشخيص المريض لاكتساب الوقت.

وبعد إجـــراء هذه التجربة والحصول علي هذه النتائج ، نلاحظ أن النتائج قريبة ومرضية للقيم المطلوبة ، لذلك تأكدنا من أن الفيلم في حالة جيدة ، وأن المريض لن يتعرض لجرعة إشعاع إضافية أثناء التشخيص.

Quality Control Of Film Processing in medical x-ray imaging

A . Asma Saeed Abogila Elmahdi
Faculty of science – El Ajelat, Zawia University

Abstract:

Film processing is playing important role of producing radiographic image. Any spoil in processing will affect the image quality, so it is important to do processing monitoring by using either commercially available sensitometer or aluminum stepwedge. Besides, the performance of x-ray machine is also important to keep it maintained ,We know the source of the radiation in the medical field especially in diagnosis X-ray department is X-ray machine ,so The quality control of film processing and x-ray machine is necessary to make sure that it meets the regulation requirements to prevent unnecessary dose to the patient undergone the diagnostic procedures.

From the study we get the follow:

- the speed of film using automatic processor is faster than manual processor. Also they are found to have the weak processing chemical for manual processor, that is why the speed is slow and they have the lower maximum density compare to auto processor. Ideally, sensitometer monitoring should be done as daily routine work and it is used to monitor the performance of film processing, darkroom and related item and equipment.

- Sensitometer Density for Exposure A and B using Auto Processor vs Manual:

i.) Measurement of film speed = Density of middle spot = 1.435 (for automatically(film A)) & 1.02 (for manually (film B))
ii.) Average gradient (gamma) = Difference of density between outer 2 spots = 0.828 (for automatically film A) & 0.575 (for manually film B)
iii.) Base plus fog density = 0.21automatically, 0.22 manually.
-The density v.s aluminum thickness curve is similar in form to the characteristic curve of a screen-film combination. The slope of the density vs. thickness curve is dependent on the exposure factor used to radiograph the aluminum stepwedge.
We can conclude that the results in this study showed us that the quality control of processing film was good in condition. These quality control procedures should be done according to the time to avoid unnecessary damages to the films and processing materials. The good implementation of quality control will produce a good image to help the consultant to diagnosis the patient. So the patient no needs to expose to unnecessary dose.

Keywords: x- ray machine, film processing , automatic processor, manual processor, aluminum stepwedge.

1.0 Objective:

To evaluate the important parameters associated with film processing.
since many factors will cause variations in the quality of processed film, so it is an important aspect of our quality assurance program , the film speed is the most important measurement in processor control and is a sensitive indicator of changes in processing. also the aim of this part of experiment is to obtain a characteristic curve for film processing by using the aluminum stepwedge. Because the high quality of x-ray machine means a good image that lead to

get the best and more details of radiographic film with a little exposure to the patient and also with low cost. And since processor operation can change in a short period of time so it should be checked daily.

2.0 Introduction And Theory

The darkroom and film processor play an important role in converting a latent image into a clearly visible image. No matter how well the film has been exposed, a faulty processing technique can completely spoil a result and so nullify the value of the radiographic image quality. One of the tests for darkroom and film processor is sensitometer monitoring. Ideally, this sensitometer monitoring is a daily routine works to monitor the performance of film processor and its chemical for certain period of time normally 3 to 4 weeks.

Patient undergoing x-ray examinations are subjected to a wide range of radiation exposure. There are several factors that affect patient exposure during a radiographic procedure. Factors that affect patient exposure may also affect image quality. In most instances when changing a specific factor to decrease exposure will also result in decrease of image quality. Therefore, the factors should be selected carefully to provide an appropriate compromise between patient exposure and image quality. (MINT, 2004).

In reality, after installation of irradiation apparatus, this irradiation apparatus must be tested to ensure conformance to its specifications. This test is known as commissioning or acceptance testing. The test is carried out to ensure that the apparatus is complied with users' requirement and fit for clinical use. It is also to provide baseline values for future comparison. Once the system is in clinical use, the apparatus must be tested regularly, at least

once a year to ensure proper functioning and continue to perform optimally. This yearly test is called Quality Control (QC) test that include the checking of mechanical and electrical safety aspects, operational radiation protection and performance standard measurements. Performance standard measurement covers the checking for kV accuracy, half value layer (HVL), focal spot size, x-ray exposure timing, film screen contact and several other test such as beam alignment, beam congruence, image quality and film-focus distance scale. (B. M. Moores (1987)).

2.1 Theory :

This experiment which for quality control of processing film is to its very important for quality assurance program to evaluate processed film which has been given a known exposure. Since Variations of chemistry (contamination, oxidation, replenishment), temperature, agitation and other factors will cause variations in the quality of processed film. Many of the variables change slowly so that daily monitoring of processor performance and plotting the results can be used to initiate corrective actions before the radiographs have decreased in diagnostic quality.

Since it is normal for x-ray generators to vary in output as much as 10% from a mean value and since the high contrast of x-ray films amplifies this variation, the use of x-ray test films i.e., wedge films, as a processor testing means is not recommended .Instead, a regulated sensitometer is used to expose a test film in the same area, the film processed at the same time each day and the operating temperatures are recorded.

This is done with the RMI processor control sensitometer uses a precision mechanical shutter and light source to give reproducible light exposure to three circle regions on a film, from these three

circles which have optical densities can measure the film speed which is important measurement (Film speed is the most important measurement in processor control and is a sensitive Indicator of changes in processing. The density of the middle step is chosen as a measure of the film speed).(3)

Three density steps are all that need to be measured. These three measurements will permit the evaluation of the speed, the average gradient (gamma), and the base plus fog density. Monitoring these three parameters will detect deterioration of film processing before there is a noticeable change in the radiographs.

The third parameter that should be recorded is the base plus fog density. This should be measured in an area of the film which has not received any x-ray exposure. This is a relatively insensitive measure of Processor change, but if it increases it indicates an inappropriate safelight in the darkroom or film pre-exposure by stray radiation.

And if an aluminum wedge must be used, expose it in the described manner. The best time to check the processor is in the morning about one hour after it is turned on.

Gammex's Aluminum Stepwedge, Model 117, is constructed of homogeneous, high purity aluminum and is designed to provide incremental exposures to x-ray film by the increased aluminum thickness in each step.

Figure1: RMI Aluminum Stepwedge

The RMI Aluminum Stepwedge has 11 steps, each 3 mm (0.12") high the wedge is 6.4 cm (2-1/2") wide and 14 cm (5-1/2") long. The aluminum used is better than 98% pure.

Step wedges are most useful when comparing the characteristic curve of various film-screen combinations. They may also be used to check mA stations and, with great care, Sensitometer, after exposed the stepwedge using the film-screen combination that is to be evaluated. Use exposure factors that will result in an image with optical densities (OD) from base + fog to approximately 3.0 OD. The densities should be plotted as a function of log exposure with the thickness of the aluminum setpwedge.

The characteristic curve is arbitrarily divided into three parts. The straight line portion relates to the diagnostic range of densities. The toe region will demonstrate limited contrast in density because it is in this range that the density is first measured. The shoulder will demonstrate maximum density on the film. (Martin,J.E, 2000)

An important factor of how a radiographic film reproduces a portion of the anatomy is the angle that the straight line portion of the characteristic curve makes with the horizontal axis. The tangent of this angle is referred to a slope of the straight line and called gamma. The steeper the slope or gamma of the curve, the greater the film contrast ,A steep slope or high gamma film will

have less latitude than a low gamma film with many shades of gray. Another value which can be obtained from the characteristic curve is the sensitivity or speed of the film.

3.0 Apparatus:

1. Diagnostic film, Konica 8” x 10”
2. Dual Colour Sensitometer, Gamex RMI X-Rite
3. Processor control sensitometer, RMI Model 201B
4. Auto processor, Minolta SRX-101A
5. RMI Aluminum step wedge
6. RMI Densitometer

Figure2: RMI sensitometer **, Figure3**: X-Rite sensitometer

Figure4: Step wedge

Figure5:.Automatic Processing

Figure6: Densitometer

4.0 Procedure:

In this experiment we have to measure the three densities, These three measurements will permit the evaluation of the speed, the average gradient (gamma), and the base plus fog density.

Monitoring these three parameters will detect deterioration of film processing before there is a noticeable change in the radiographs. And to comparing the characteristic curve of various film-screen combinations. They may also be used to check mA stations and, with great care, Sensitometer, after exposed the stepwedge.

a. Using 21 step density from a sensitometer (Dual Colour Sensitometer, Gamex RMI X-Rite), record the measured densities and plot the graph for an effective Quality Assurance Program.

B. Using three step density from a sensitometer (Processor control sensitometer, RMI Model 201B), record the measured densities and plot the graph for an effective Quality Assurance Program

c. Using an RMI Aluminum stepwedge for a known exposure (76kV, 5mAs), obtain a characteristic curve for the x-ray film.

-we can explain it by two steps:

4-1 RMI processor control sensitometer using automatic and manual processing.

4.2-Using an aluminum stepwede**.**

4.1.1 RMI processor control sensitometer procedure :

This experiment is done in two methods ,manually and automatically process Used afresh blue film 8" x 10" we will exposed it by the RMI sensitometer at a dark room, which the RMI process control sensitometer uses precision mechanical shutter and light source to give are producible light exposure to three circular regions on the film, firstly the sensitometer should be warm up about10 minutes the light source continually on when the unit is plugged on, the film is then ready to be exposed slip the film between the box and the spring clam(at the edge of the film).then press the exposure button, and the red light should come on to know that the film is exposure and repeat this operation for the

other side of the film to get the three circular region with optical densities. then we will exposed the both other sides film by the RMI X- rite sensitometer which will gives the 21 steps of the gray scale, after that the film will be developed to evaluate the trace of the exposure, we did these steps for three days using three films and made measurements twice a day AM and PM, these traces densities (the three spots & the21 lines) have a specific important details to be explained, we will discussed them in the results.

4.1.1.1 The manual process:

This method is called manually according to the way of developing the film, In dark room, we prepared three small vats contained (developer, water and flaxier) the film should be firstly sinking in developer for 4 minutes secondly the film should be washed in water for 2 minutes. After that, the film was dipped in fixer for about 6 minutes then the developed film washing with fluent water for about 30 minutes after that the film was being hugged to being dry. The same procedure was repeated until we will get a good image, from the developed films we will measured the optical density (O.D) using a densitometer.

4.1.1.2 The automatic process:

At the same way of exposure film which indicated previously the exposure film will developed by a such machine (Minolta SRX-101A) the machine should be turned on before about 30 minutes from inserting the exposed film inside to be developed ,to warm up. then the film will be developed immediately by the machine so in this method we can get the result faster.

4.2Using the aluminum stepwedge Procedure:

Reload the cassette in a dark room with afresh blue film and make sure that the cassette looked well after that we will divide

the cassette area into two parts by covering the area without the stepwedge by apiece of shield (lead used) each area will exposed with different amount of kvp and mAs to take two images collimate the x-ray beam at the center of the step wedge. Expose the stepwedge, using the film-screen combination that is to be evaluated both at 100cm distance from the x-ray beam to the cassette .

we exposed the film at 70Kvp and 6.3mAs.

After exposure the film and developed it by the machine we will measure the optical densities trace by the densitometer (OD). The densities should be plotted as a function of log exposure with the thickness of the aluminum setpwedge, which is represented in a curve the density vs. thickness of aluminum curve is similar in form to the characteristic curve of a screen-film combination. The slope of the density vs. thickness curve is dependent on the exposure factor used to radiograph the aluminum stepwedge. Another value which can be obtained from the characteristic curve is the sensitivity or speed of the film.

3.0Reference (standard):

-Acceptable variation from day to day is ±0.1 OD(optical density)for speed and gradient.

-Base plus fog density (B+ F) ±0.02.

-The optical density of three circular regions on a film about 0.5,1,and 2 above surrounding unexposed area.

-The density of the middle spot is measure of the film speed.

-The difference in densities of the outer two spots is the average gradient (contrast of the radiographic film).

Note : we use blue film in our experiment.

5.0 Result And Discussion:

In this experiment, the OD(optical density) values obtained for the films processing manually and automatically are recorded as the following:-

(1)

automatically

Strips	Sensitometer readings	
	Left side	Right side
1	0.18	0.18
2	0.18	0.18
3	0.18	0.18
4	0.19	0.19
5	0.2	0.21
6	0.24	0.24
7	0.3	0.3
8	0.42	0.42
9	0.66	0.67
10	0.98	0.99
11	1.42	1.43
12	1.89	1.92
13	2.26	2.28
14	2.58	2.58
15	2.75	2.75
16	2.8	2.8
17	2.8	2.82
18	2.78	2.8
19	2.74	2.78
20	2.73	2.77
21	2.71	2.75

(2)

Manually

Strips	Sensitometer readings	
	Left side	Right side
1	0.19	0.2
2	0.2	0.2
3	0.2	0.2
4	0.21	0.21
5	0.23	0.22
6	0.25	0.26
7	0.31	0.31
8	0.42	0.41
9	0.62	0.61
10	0.89	0.89
11	1.27	1.25
12	1.64	1.66
13	1.94	1.98
14	2.19	2.21
15	2.34	2.39
16	2.43	2.44
17	2.43	2.45
18	2.42	2.46
19	2.42	2.45
20	2.42	2.45
21	2.41	2.43

Table 1: OD for every step of sensitometer (Automatically).

Table 2: OD for every step of sensitometer (Manually).

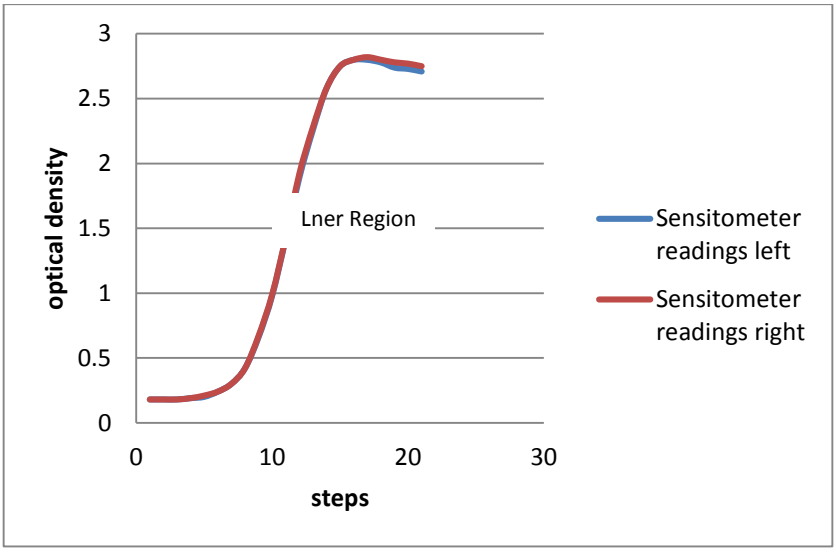

Figure 7:- Graph OD versus Step number for automatic processing.

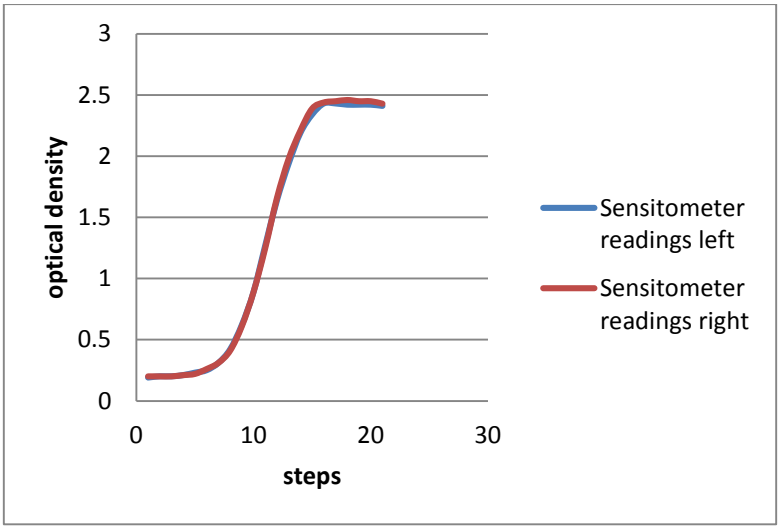

Figure 8: Graph OD versus Step number for manual processing.

The comparison between manually and automatically developed film:

Steps	OD	
	Manual	auto
1	0.195	0.18
2	0.2	0.18
3	0.2	0.18
4	0.21	0.19
5	0.225	0.20
6	0.255	0.24
7	0.31	0.3
8	0.415	0.42
9	0.415	0.665
10	0.415	0.985
11	0.615	1.425
12	0.89	1.905
13	1.26	2.27
14	1.65	2.58
15	1.95	2.75
16	2.2	2.8
17	2.365	2.81
18	2.44	2.79
19	2.435	2.76
20	2.43	2.75
21	2.42	2.73

Table 3: The comparison between manually and automatically developed film.

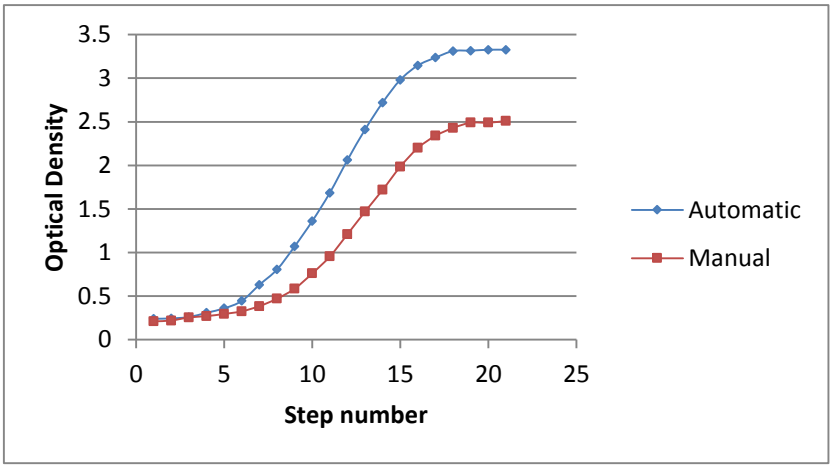

Figure 9 :The characteristic curves for film processed manually and automatically (automatic processor v.s manual processor).

the both sides film exposed by the RMI X- rite sensitometer which will gives the 21 steps of the gray scale, the graph shown the relationship between average density and steps for the exposed film used for processor quality control**.**

By Using the aluminum stepwedge Procedure:

Aluminum thickness	OD values	
	auto	manual
3.46	0.23	0.26
3.15	0.27	0.3
2.825	0.26	0.38
2.515	0.52	0.51
2.205	0.8	0.73
1.895	1.18	1.02
1.575	1.64	1.41
1.26	2.14	1.81
0.955	2.55	2.19
0.64	2.81	2.5
0.32	2.91	2.66
0	2.92	2.7

Table 4: Optical density and thickness of Aluminum stepwedge

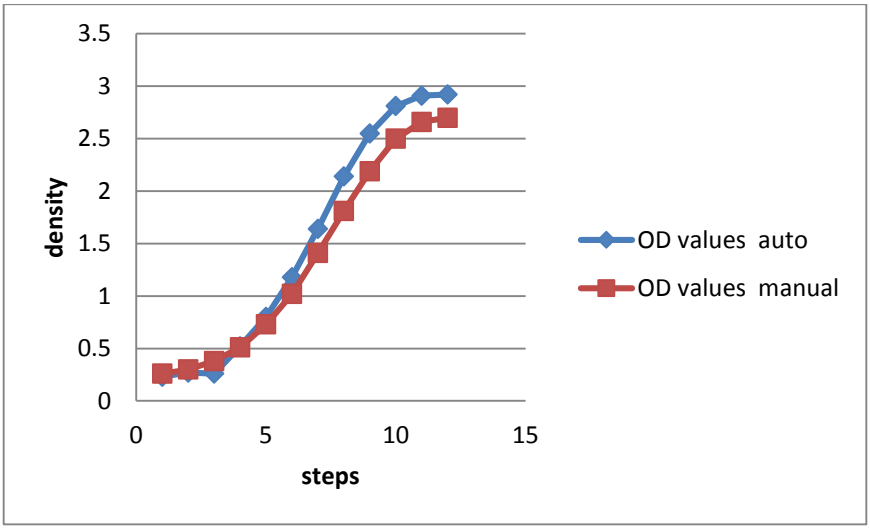

Figure 10: Plotted graph of characteristic curve by using RMI Aluminum Stepwedge.

For the Aluminum stepwedge the exposure is in the form of eleven steps. Eleven steps are useful for plotting characteristic curve but are unnecessary for processor control. Three densities are all that need to be measured. These three measurements will permit the evaluation of the speed, the average gradient (gamma), and the base plus fog density. Monitoring these three parameters will detect deterioration of film processing before there is a noticeable change in the radiograph. Three steps that have optical densities of about 0.5, 1.0, and 2.0 above the unexposed area of the film and are chosen and get the reading with a densitometer.

Film speed is the most important measurement in processor control and is a sensitive indicator of changes in processing. The density of the middle step chosen is a measure of the film speed. The difference in densities of the outer two steps chosen is an indication of the average gradient (gamma). The average gradient is related to the contrast in the processed film. The third parameter that should be recorded is the base plus fog density. This should

be measured in an area of the film that which has not received any x-ray exposure. This is a relatively insensitive measure of processor change, but if it increases it indicates an inappropriate safelight in the darkroom or film pre exposure by stray radiation.
The densities should be plotted as a function of log exposure with the thickness of the aluminum setpwedge ,which is represented in a curve the density vs. thickness of aluminum curve is similar in form to the characteristic curve of a screen-film combination. The slope of the density vs. thickness curve is dependent on the exposure factor used to radiograph the aluminum stepwedge.
We observe from the graph that the exposure is inversely proportional with the thickness of the aluminum stepwedge, the higher thickness the smaller x-ray penetrate the aluminum and it should be adjusted to get a good radiograph with a small exposure to individual.

5.1 Three dotes indicated:

Using the sensitometer RMI Model 201B, there are three dotes indicated:

Dark dot	Gradient
Medium dot	Film speed
Lightest dot	Gradient
The changes from dark to light	Average gradient
Region without dot	Base+fog

Table 5:type to three dotes indicated.

The average gradient(gamma) which represented by the difference between the high and low spots, the density values should be 0.25 and 2.0 above the base +fog, and it is used to determined the average gradient(gamma).

High film peed low

= 1, = 2, = 3

All base + fog values are within the tolerance limit (<0.25 OD), that means no significant light leakage in the darkroom but not include for the safe light because for this experiment the safe light is switched off due to high fogging effect on the film.

In this part we will show a good quality control of processing film by using 3 steps densities:

Processing Method	Automatically(A)			Manually(B)		
	OD upper side	OD lower side	Average OD	OD upper side	OD Lower side	Average OD
Dark dot	2.29	2.3	2.295	1.62	1.62	1.62
Medium dot	1.42	1.45	1.435	1.02	1.02	1.02
Lightest dot	0.63	0.65	0.64	0.5	0.5	0.5
Base + Fog	0.21			0.21		

Table 6: Optical density(OD) for manual processing and automatic processor using RMI Processor Control Sensitometer.

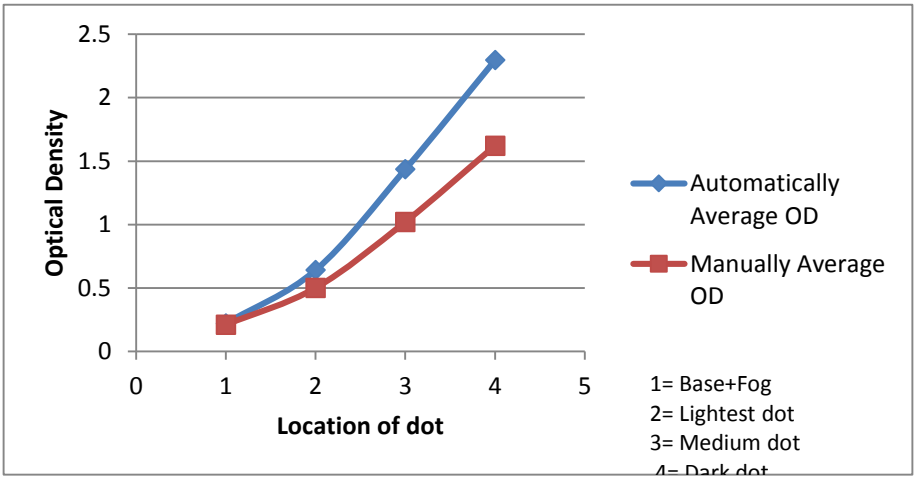

Figure 11: Graph Oprical Density versus steps sensitometer (RMI Model 201B)

From Table 6 above it show that:-

Processing Method	Automatically	Manually
Base + Fog	0.21	0.22
Speed	1.435	1.02
Average Gradient [(Dark dot-light dot)/2]	0.828	0.575

Table6 : processing method for manual processing and automatic processing .

From Figure 7, Figure 8,Figure 9,10 and Figure 11 they are found to have the weak processing chemical for manual processor, that is why the speed is slow and they have the lower maximum density compare to auto processor. Ideally, sensitometer monitoring should be done as daily routine work and it is used to monitor the performance of film processing, darkroom and related item and equipment.

6.0Conclusion:

The quality control program reported in this study provides a necessary part of the quality assurance programs in medical X-ray imaging department to get the large benefit from the machine with low exposure and costs.

Sensitometer monitoring is a test performance of film processing, darkroom and related items and equipment. This test can reveal the condition of processing chemical, darkroom and safelight by referring to the value of base + fog, speed index, contrast index and the pattern of the curve formed. The type of film sensitivity such as green or blue sensitive film can be determined by using dual color sensitometer which can emit the green and blue light. All tests have special dedicated test tool that have to be maintained

and calibrated to make sure the measurement done is accurate and reliable.

In this study we focus at the quality control of processing film which it's very important steps to check the film processing at a good condition, because many factors may affect on the quality of the film such as bad storage or expired film date so the radiographer should make the operation with a good film conditions, to get a clear image with low exposure to the patients. and since processor operation can changed in a short period of time so it should be checked daily. after we doing the procedure of this experiment and get the results we note that the results are close and satisfying to the acceptable values so we have ensured that the film is in a good conditions.

7.0 References :

(1) MINT (2004). Medical X-Ray. Malaysian Institute for Nuclear Technology Research (MINT), Malaysia.

(2) B. M. Moores (1987). Practical Guide to Quality Assurance in Medical Imaging, John Wiley & Sons Ltd., Great Britain.

(3) MS 838 (1983), Malaysian Standard, Code of Practice for Radiation Protection (Medical X-ray Diagnosis), SIRIM, Malaysia.

(4). Xray definition of X-ray in the Free Online Encyclopedia.htm

5) Martin,J.E, 2000, Physics For Radiation Protection, First Edition, A Wiley-Interscince Publication.

6)Johns,H.E.1983,The Physics Of Radiology, Fourth Edition, Charles.S.Thomas.

7) Knol,G.F, 1999, Radiation Detection and Measurement , Third Edition, Johon Wiley and Sons ,Inc.

(8). AAPM REPORT No. 4 BASIC QUALITY CONTROL IN DIAGNOSTIC RADIOLOGY.

(9) Automatic X-ray Film Processor FP 2000 F.htm (www.google.com)

(10) Standard Operating and Quality Assurance Procedures X-Ray Generating Equipment Department of Environmental Health and Safety Revised, August 2007.

(11) Biomedical Ertgtneenng. Vol. ~0, No. 5, 19961~. G. Chikirdin and V. I. Zakharova.
(12) The manual of the laboratory of the department in USM.