Radiological Equipment Techniques (Lec8)

Grid types

1. Grid types

1.1 Parallel Grid

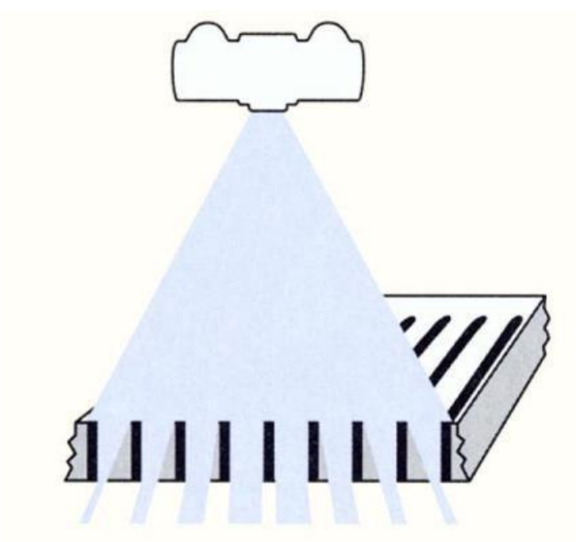
The simplest type of grid is the parallel grid, which is diagrammed in figure below.

In the parallel grid, all lead grid strips are parallel.

Parallel grids clean up scatter radiation in only one direction along the axis of the grid.

This type of grid is the easiest to manufacture, but it has some properties that are clinically undesirable, namely grid cutoff, which is the undesirable absorption of primary x-rays by the grid.

The attenuation (absorption) of primary x-rays becomes greater as the x-rays approach the edge of the image receptor. the X-ray intensity reaches a maximum along the center line of the image receptor and decreases toward the sides.

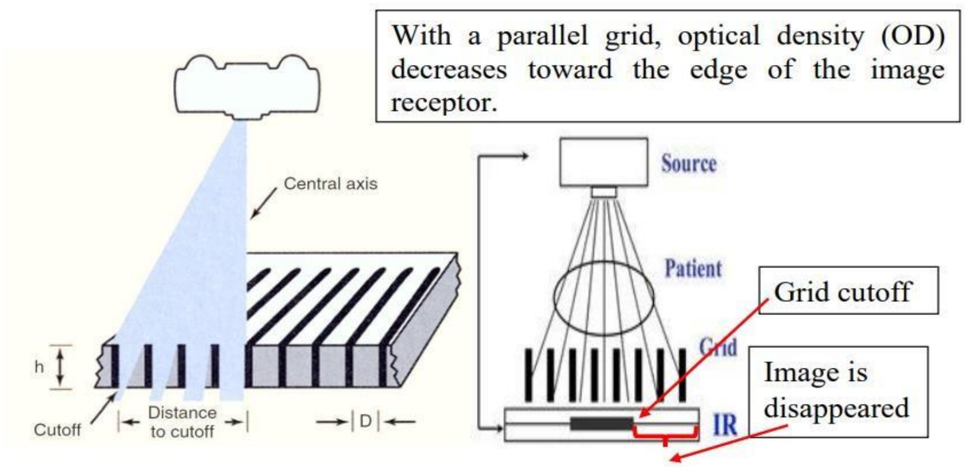


A PARALLEL GRID IS CONSTRUCTED WITH PARALLEL GRID STRIPS. AT A SHORT SOURCE-TO-IMAGE RECEPTOR DISTANCE (SID), SOME GRID CUTOFF MAY OCCUR.

The distance from the central ray at which complete cutoff will occur is determined by the following:

Distance to cutoff = $SID\ /\ Grid\ ratio$

Where SID: The source to image distance.



Question: A 16: 1 parallel grid ratio is positioned for chest radiography at 180 cm SID.

1-What is the distance from the central axis to complete grid cutoff?

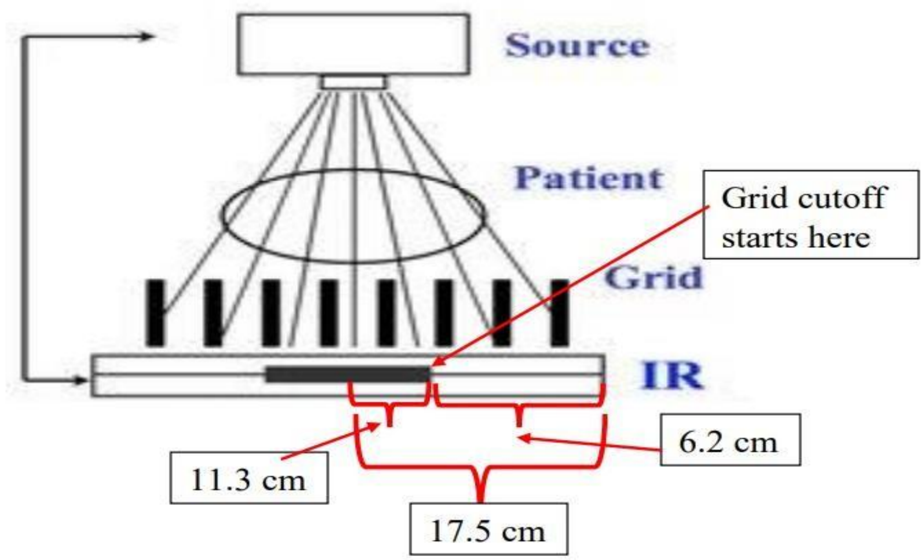
2-Will the image satisfactorily cover a 35 cm (width)- × 43 cm (length) image receptor?

Answer:

Distance to cutoff = $SID\ /\ Grid\ ratio$ = 180 / 16 = 11.3 cm

Distance from center to edge of image receptor = $Width\ of\ image\ receptor\ /\ 2$ = 35 / 2 = 17.5

No! Grid cutoff will occur on the lateral 6.2 cm (17.5−11.3) of the image receptor.



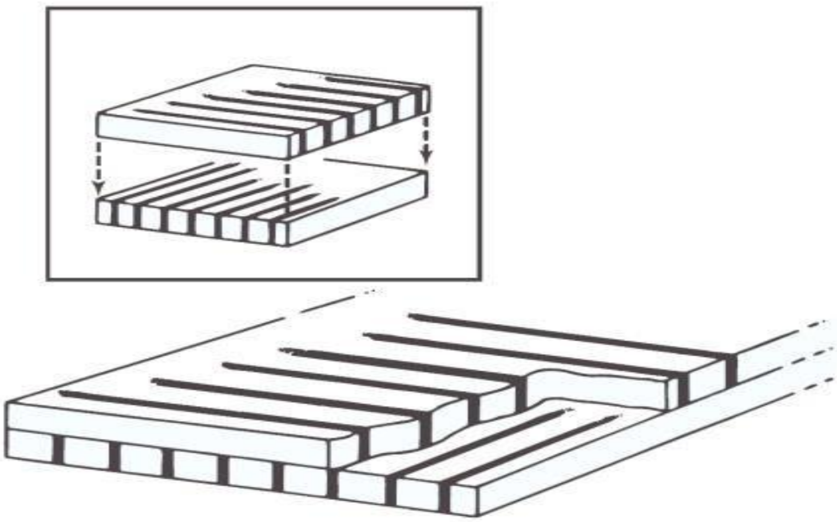
1.2 Crossed Grid

Crossed grids are designed to overcome the shortcomings of parallel grids.

Crossed grids are usually fabricated by placing two parallel grids together with their grid strips perpendicular to each other (figure below).

Crossed grids are much more efficient than parallel grids in cleaning up scatter radiation. Crossed grids has cutoff distance.

A 6:1 crossed grid will clean up more scatter radiation than a 12:1 linear grid (two dimensions' removal).



disadvantages of crossed grids.

1- Positioning the grid is critical; the central ray of the x-ray beam must coincide with the center of the grid. (any deviation can cause significant grid cutoff) 2- Results in higher patient radiation dose.

1.3 Focused Grid

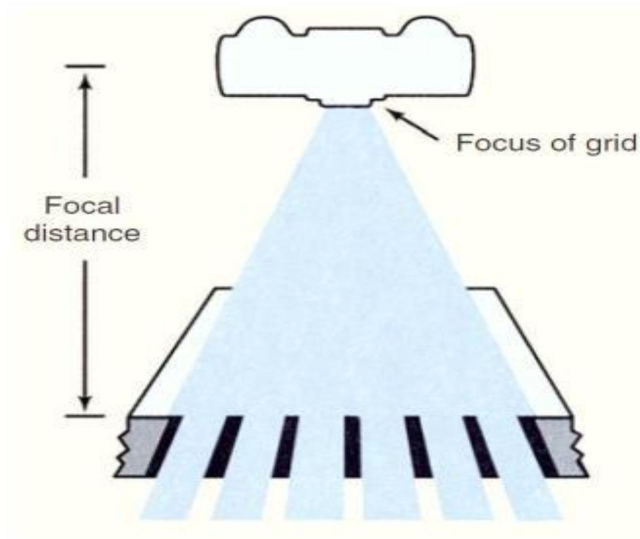
The focused grid is designed to minimize grid cutoff.

The lead strips are slightly angled towards the focal spot. The grid can therefore be used only at a specified focal distance.

If the focus grid placed out of focal distance, then the grid will absorb the primary x-ray and parts of the film are barely exposed.

Focused grids can be linear or crossed.

Grid focal distance refers to the alignment of the primary x-ray with each of the strips.



1.4 Moving grid

All stationary grids show grid lines on the radiograph. Thinner lead strips show less noticeable lines. However, thinner strips not cleaning up scatter radiation well.

The mechanism of moving grid is that; the grid lead strips keep moving during the xray exposure. Thus, the grid lines (lead strips) will disappear from the radiograph.

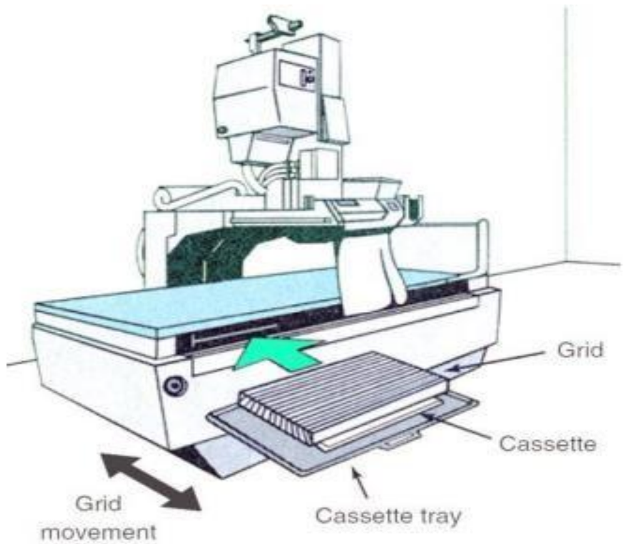
Moving grids are made of focused grids.

There are three types of moving grid mechanisms:

1- single - stroke grid: The mechanism causes the grid to move continuously across the film while the x-ray exposure is being made, usually it is spring loaded.

2-A reciprocating grid is a moving grid that is motor driven back and forth several times during x-ray exposure. The total distance of drive is approximately 2 cm.

3- An oscillating grid is positioned within a frame with a 2- to 3-cm tolerance on all sides between the frame and the grid. A powerful electromagnet pulls the grid to one side and release it.



2 Grid selection

2.1 Grid selection factors

Grid selection factors are:

1. Patient radiation dose increases with increasing grid ratio.
2. High-ratio grids are used for high-kVp examinations.
3. The patient radiation dose at high kVp is less than that at low kVp.

2.2 Selection of grid ratio

The selection of a grid with the proper grid ratio depends on an understanding of three interrelated factors:

1-kVp

2-Degree of scatter radiation reduction

3-Patient radiation dose **1-**

kVp:

When a high kVp is used, then more scatter is produced. Therefore, high-ratio grids should be used.

The choice of grid is also influenced by the size and shape of the anatomy that is being radiographed.

2- Degree of scatter radiation reduction:

As grid ratio increases, scatter radiation attenuation also increases.

In general, grid ratios up to 8 : 1 are satisfactory at tube potentials below 90 kVp. Grid ratios above 8 : 1 are used when kVp exceeds 90 kVp.

When using higher grid ratio, the difference in patient dose is large. Therefore, 16:1 grids (high ratio) are not often used.

Many general-purpose x-ray examination facilities find that an 8:1 grid represents a good compromise between the desired levels of scatter radiation reduction and patient radiation dose.

The use of one grid also reduces the likelihood of grid cutoff because improper grid positioning can easily accompany frequent changes of grids.

3- Patient radiation dose:

When a grid is used, technique factors must be increased over what they were for nongrid examinations: The mAs or the kVp must be increased. Thus, radiation dose to the patient is increased.

One major disadvantage of using radiographic grids is increased patient radiation dose.

The use of a grid results in several times more radiation to the patient than is provided when a grid is not used.

The use of a moving grid instead of a stationary grid with similar physical characteristics requires approximately 15% more patient radiation dose.

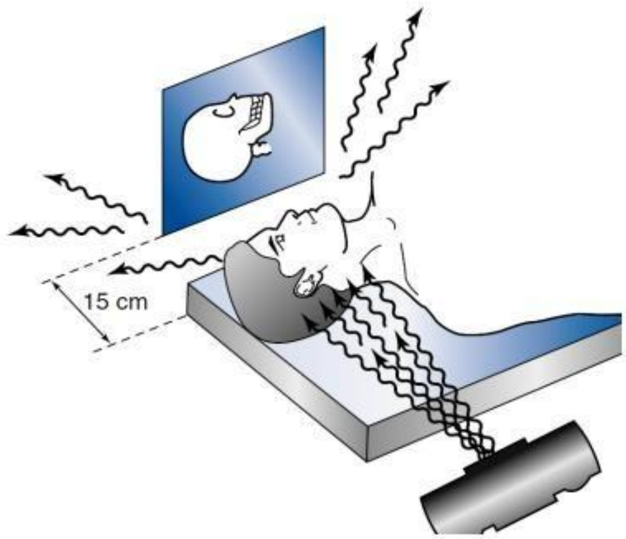
Table below is a summary of approximate patient radiation doses for various grid techniques with a 400-speed image receptor.

Adult Pelvis With a 400-Speed Image Receptor	ENTRANCE DOSE (mGy_t)		
Type of Grid	**70 kVp**	**90 kVp**	**110 kVp**
No grid	0.4	0.35	0.25
5:1	1.4	1.1	7.5
8:1	1.6	1.4	1.0
12:1	2.1	2.0	1.5
16:1	2.6	2.4	1.9
5:1 crossed	2.7	2.0	1.5
8:1 crossed	2.9	2.7	2.0

2.3 Air-Gap Technique

The air gap technique is an alternative to using a grid to control/reduce the scatter radiation reaching the image receptor.

When moving the image receptor away from the patient, more scatter radiation will miss the image receptor. The greater the gap, the more the scatter is reduced from radiograph.



Similar to using a grid, the image contrast is increased, the number of x-ray reaching the image receptor is reduced, and the mAs must be increased to compensate.

There may be slightly less need to increase mAs compared to using grids because a grid strips absorbs some of the transmitted photons, whereas the air gap technique does not.

Usually, when an air-gap technique is used, the mAs is increased to compensate by approximately 10% for every centimeter of air gab.