TECHNIQUE CHART CONSTRUCTION

Introduction

The fundamentals of quality radiographic imaging are based on several variables.

- X-ray producing unit with quality and consistent output
- Precise and repeatable x-ray technique
- Image capture system – film or digital
- Correct patient positioning
- Accurate darkroom procedures and film development for film/cassettes systems

Technique charts are unique to each x-ray unit, film/cassette or digital capture system and are a necessity for producing consistent, quality radiographs with minimal retakes. While generic technique charts may be supplied with the purchase of a new x-ray unit it is vital to remember that these techniques are only a suggested starting point. Due to the inherent variables of each imaging system and various species and anatomical differences a set of customized technique charts specific to each x-ray unit must be constructed.

Variables that make a technique chart necessary

- Incoming voltage
- Inherent differences in machines
- Speed of film/screen or digital system
- Age/ condition of intensifying screens
- SID (source to image distance)
- Beam Filtration
- Processing time/ temperature and age/quality of chemicals
- Grid

X-ray Generation

X-rays are generated in an x-ray tube consisting of a cathode (negative charge) and an anode (positive charge). The cathode consists of a wire filament that emits electrons when heated. The filament temperature is controlled by the milliamp (mA) setting. As mA increases, the temperature of the filament is increased producing more electrons. The period of time allowed for electrons to leave the x-ray tube is divided into fractions of a second (s) and determines how many x-rays are available. The number of electrons and period set for release determine how many x-rays are available (mA x s). .

mAs = (mA)(seconds) = total # of x-ray's produced.

The electron speed necessary to create a high-energy impact is achieved by applying thousands of volts (kilovoltage – kV or kilovoltage peak - kVp) across the anode and cathode field. Increased voltages produce x-rays with greater penetrating power and intensity resulting in more x-rays reaching the film.

kVp = controls the penetrating power of the x-rays.

Gray scale	High kVP = long scale of contrast (many shades of gray) or labeled low contrast. Good for soft tissue examinations. Low kVp = short scale of contrast (blacks and whites) or high contrast. Good for bone studies.

Image Processing

Poor radiographic quality with film imaging is many times caused by improper darkroom technique or poor quality chemicals. Automatic processors provide a consistent processing procedure, fast film through put and maintain proper chemical concentration however; processors must be used on a regular basis to ensure proper performance. Many low volume veterinary clinics do not perform an adequate volume of radiographs to warrant the investment of an automatic processor.

Hand processing factors that may affect the quality of the finished radiograph

- Concentration of processing chemicals - Age of chemicals
- Degree of chemistry agitation during development
- Chemical temperature
- Development time
- Non-agitated chemicals
- Chemical contamination

Technique Chart Construction – Companion Animal

1) Before you begin

1. Have processor serviced if using automatic processor.
2. Hand processing:
   Use fresh chemicals at correct temperature (generally 68°F [20°C]).
   Stir chemicals using separate paddles for developer and fixer.
3. Confirm film is not outdated.
4. Cassettes should be clean and in good working order. Screen efficiency does degrade with age.
5. Know speed of system. All cassettes/ screens should match.
6. Confirm incoming line voltage.
7. Determine SID in inches (will remain constant) and record on chart.
8. Select grid and know specifications.

2) Select Patient:

Average size dog (approx 40-50lbs) with clean coat, either anesthetized or a good patient. The initial technique chart will be constructed for abdominal settings. Other anatomical regions can be extrapolated from this chart.

3) To Begin

1. With patient in lateral recumbency, measure the abdomen at approximately the twelfth rib. Our 50 lb patient measures 12 cm.
2. SID is 32 inches (generally 40" for large stationary systems)
3. Grid is 6:1 – To avoid confusion we will use a grid for all thoracic, abdominal and pelvic imaging. If table top imaging is preferred for smaller patients you may reduce the mAs setting listed on the technique chart by half.

Initial kVp setting:

Sante's rule:

(2x measured thickness) + SID + (grid factor if > 10 cm) = kVp

Grid Factor Ratio	Added kVp tp sum of Sante's Rule
5:1	6-8
8:1	8-10
12:1	10-15
16:1	15-20

Initial mAs setting:

Screen Type	mAs
Fast (High Speed)	2.5 – 10
Medium (Par Speed)	5-12.5
Slow (Ultra Detail)	30-40

Advantages of high mA

Shorter exposure time = less chance of patient movement

Ability to examine thicker anatomic regions

4) Trial Exposure

kVP (2x measured thickness) + SID + (grid factor if > 10 cm) = kVp

(2 x 12) + 32 + 8 = **64 kVp**

mAs A good starting point for mAs setting for our 50 lb dog is **7.5 mAs**.

5) Evaluate Film Technique

Evaluate the exposure technique by the following parameters:

Density – the degree of blackness

Contrast – density difference between two areas of a finished radiograph. For abdominal imaging we prefer a longer gray scale to differentiate between soft tissue structures (low kVp).

If technique modifications are required follow the following rules:

Too Dark – over penetration:

Observe contrast between bone and surrounding soft tissue.

If bone is gray without much contrast – lower the kVp by 10-15%.

If bone is white compared with surrounding soft tissue – lower the mAs by 30-50%.

Too Light

Adequate penetration – silhouettes of internal organs are visible. Increase the mAs 30-50%.

Inadequate penetration – outline of abdominal structures not visible. Increase the kVp by 15%.

	Film too Dark	**Film too Light**
	Sufficient contrast between bone and soft tissue?	Outline of abdominal structures visible?
YES	↓mAs 30-50%	↑ mAs 30-50%
NO	↓kVp 10-15%	↑ kVp 15%

6) Retake abdominal film if needed following the guidelines shown above until a perfect film exposure is obtained.

7) Extrapolate values from "perfect technique" film for abdominal technique chart as follows:

- Add 2 kVp for each cm increase from the original measurement up to 80 kVp.
- Add 3 kVp for each cm increase between 80-100 kVp
- Subtract 2 kVp for each cm decrease from the original measurement

SID: 32"

ABDOMEN

Grid Ratio: 6:1

THICKNESS (cm)	kVp	mAs
8	56	7.5
9	58	7.5
10	60	7.5
11	62	7.5
12	64	7.5
13	66	7.5
14	68	7.5
15	70	7.5
16	72	7.5
17	74	7.5
18	76	7.5
19	78	7.5
20	80	7.5
21	82	7.5
22	84	7.5
23	86	7.5
24	88	7.5
25	90	7.5

8) **"Tweaking" the technique chart**

As discussed previously it is preferable to use high kVp for soft tissue exams due to the longer scale of contrast. To modify the extrapolated techniques to allow for higher kVp settings use the following rule:

- Add 10 kVp then halve the mAs

An example of a modified chart is seen below.

SID: 32"

ABDOMEN **Grid Ratio: 6:1**

THICKNESS (cm)	kVp	mAs
8	76	1.9
9	78	1.9
10	70	3.75
11	72	3.75
12	74	3.75
13	66	7.5
14	68	7.5
15	70	7.5
16	72	7.5
17	74	7.5
18	76	7.5
19	78	7.5
20	80	7.5
21	82	7.5
22	84	7.5
23	86	7.5
24	88	7.5
25	90	7.5

9) Additional technique charts should be constructed for alternate anatomical regions and various species.

1. Sante's rule for the initial kVp settings.
   Remember: High kVp for soft tissue exams (longer gray scale)
   Lower kVP for bone studies (shorter gray scale)
2. Initial mAs settings:
3. Thorax – 5 mAs
4. Pelvis – 10 mAs
5. Cats – halve the mAs from dog abdominal technique