



Two new methods to scale pelvic radiographs without a radio opaque scaling object

C Meyer, F Cook,
G Cheung, R Gilbert, G Pavlou and R Spencer-Jones

Abstract

The use of calibration devices has caused concern regarding accuracy, excessive use of x-rays, infection control and increased workload for the radiology department. The two new techniques described in this study address these concerns. Neither technique requires a radio-opaque scaling object.

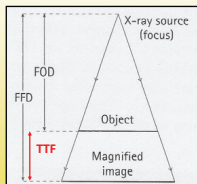
35 consecutive hip replacements had routine post operative AP pelvic x-rays. Magnification was calculated using a Calibration Ruler and a Laser method. These methods utilise the greater trochanter as an indirect measure of the height of the hip joint. A mathematical equation is used to calculate magnification. Magnification was also calculated using a "Calibration Ball" placed between the patient's thighs. These three techniques were compared against "Real magnification". Real Magnification could be calculated since the size of the arthroplasty components was known.

The Calibration Ruler and Laser methods were accurate to 0.8% (0 – 3.0%) and 1.4% (0% – 3.4%) respectively. The Calibration Ball was accurate to 11.2% (0 – 16.8%). The Calibration Ball was least popular with the patients (94% men, 100% women). Both the Calibration Ruler and Laser methods are quick and easy to learn and acceptable to patients and radiographers. The equipment, especially the calibrated ruler, is small, light, robust and inexpensive.

Magnification without Calibration device?

- (FFD) Focal film distance
- (FOD) Focal object distance
- (TTF) Trochanter to film

If TTF and FOD are known magnification can be calculated



$$\text{Magnification} = \text{FFD} / \text{FOD}$$

Materials & Methods

- 35 patients
- Post op x-ray (THR)
- Implant size noted at surgery → Real magnification
- Standardised radiographic technique
 - FFD 120cm
 - Hips internally rotated 15 degrees
- 3 methods to calc magnification
- 3 observers:
 - (Rad) Radiographer (Reg) Ortho Registrar (PM) PACS manager

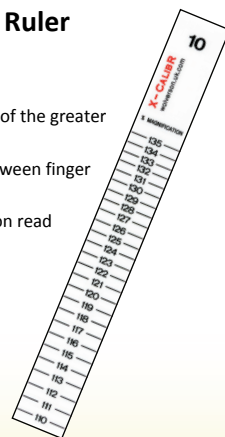
Method 1: Laser Pointer

- Calculates height of greater trochanter above table
- Table to film distance is constant
- Trochanter to Film distance (TTF) can be calculated



Method 2: Calibration Ruler

- FFD fixed at 120cm
- Table to film distance is constant
- Only variable to change is height of the greater trochanter
- Greater trochanter identified between finger and thumb
- Mid point identified, magnification read from scale



Method 3: Calibration Ball

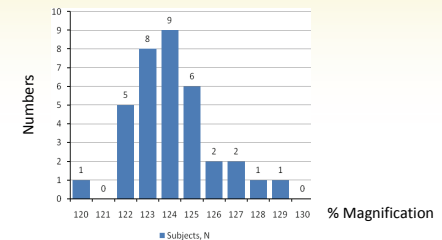
- 28mm sphere
- Positioned between thighs (by radiographer only)
- PACS software used to calculate magnification



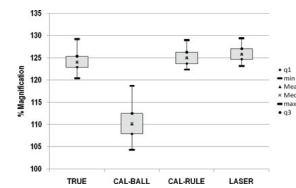
Results

Real Magnification

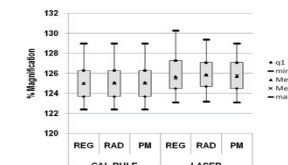
- N=35
- 19men, 16women
- Range of age and body weight
- Av magnification 124%



Estimates by the Radiographer



Estimates by all three observers



No difference in estimates between observers

Cal-Rule: Friedman test χ^2 0.19 $p > 0.90$
Laser: Friedman test χ^2 1.38 $p > 0.50$

1. Average magnification for 3 observers

Method	Magnification			
	Mean	Median	Interquartile range (q)	Total range
True Mag	124.1	124.1	122.9, 125.4	120.4, 129.2
Cal-Rule	125.1	125.0	123.7, 126.3	122.4, 129.0
Laser	125.8	125.6	124.4, 127.2	123.1, 129.6

2. Difference in magnification from Real magnification

Calculation of Difference (subtraction)	Difference between Estimates of Magnification			
	Mean	Median	Interquartile range (q)	Total range
Cal-Rule – True Mag	1.0	0.9	0.5, 2.1	-2.7, 3.7
Laser – True Mag	1.7	1.8	1.2, 2.9	-2.0, 4.2

3a. % Error for all 3 observers

Method	Relative Error % (REPS)			Total range
	Mean	Median	Interquartile range	
Cal-Rule	0.83	0.72	0.40, 1.68	-2.09, 2.98
Laser	1.37	1.44	0.93, 2.32	-1.54, 3.41

3b. % Error for Radiographer

Method	Relative Error % (REPS)			Total range
	Mean	Median	Interquartile range	
Cal-Rule	0.80	0.72	0.32, 1.72	-2.09, 2.98
Laser	1.45	1.49	0.97, 2.45	-1.20, 3.30
Cal-Ball	-11.22	-10.88	-12.59, -9.18	-16.76, -5.87

4. Predicted values of offset and proximal stem width using the three methods at their maximum error

Real Magnification 123.1%
Real values of Femoral offset 44mm, Proximal Width 30.5mm

	CAL-RULE	LASER	CAL-BALL
	Predicted Mag 126.8% (REPS: 3.0%)	Predicted Mag 127.3% (REPS 3.7%)	Predicted Mag 102.5% (REPS 16.8%)
Predicted Offset	42.7mm	42.5mm	52.8mm
Predicted Width	29.7mm	29.5mm	36.7mm

Conclusions

- Calibration ball least popular
 - 94% men / 100% women
- Ruler easiest to use and quickest
- Ruler and laser both accurate
- Both methods acceptable to radiographers and patients
- The equipment is light and inexpensive
- Calibration ruler current method of scaling pelvic x-rays at RJAH

