

Length measurement in small neonates

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SUMMARY The Prematometer is a new instrument for the accurate measurement of the length of small neonates inside incubators. It is capable of giving precise results.

Growth of low birthweight babies is usually assessed by measuring changes in weight because this measurement is the easiest to record. Changes, however, are due to alterations in all the body constituents (that is water, carbohydrate, fat, protein, and minerals) and in low birthweight babies, these may merely reflect a change in body water content rather than actual growth and cell multiplication. The measurement of the occipitofrontal head circumference is an important clinical indicator, which represents and correlates closely with brain growth and can be measured fairly easily inside an incubator.

The length of the baby is the best assessment of skeletal growth. Until now, however, there has been no instrument available for accurately measuring the crown to heel length of babies inside incubators, apart from the conventional tape measure. Taking measurements inside an incubator has distinct

advantages as it is much less physically disturbing to the neonate and reduces the risk of a fall in temperature. As some of the very low birthweight babies spend several weeks inside incubators it is important to be able to measure length as physical growth is considered as an integrated increase in weight, length, and volume.

The Neonatometer,¹ designed to measure newborn babies' crown heel lengths, is accurate, but too large to be used inside an incubator. Holtain has produced a similar instrument, called the Prematometer, which can be used inside an incubator and we have conducted an evaluation of its accuracy and usefulness.

Materials and methods

The Prematometer (Fig 1) consists of a hollow aluminium frame supporting a freely moving car-

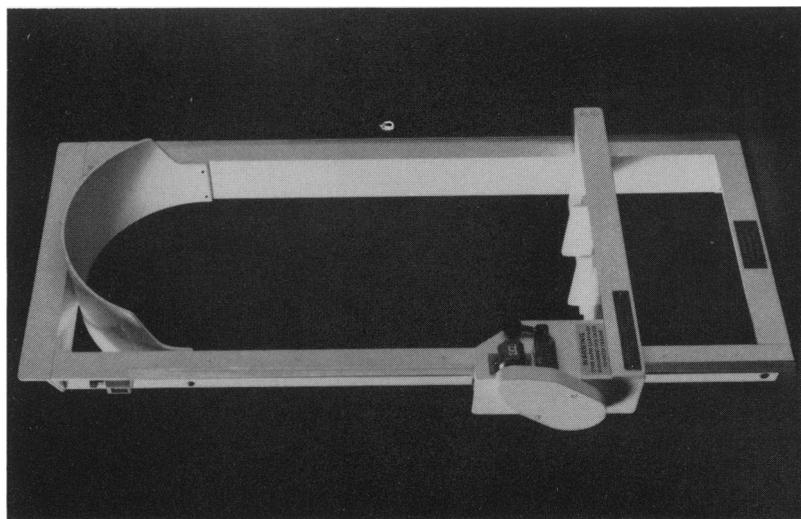


Fig. 1 *The Prematometer.*

riage. The head piece is curved to permit accurate location of the baby's head and a foot plate is mounted centrally on the mobile carriage. A number counter attached to the carriage gives a direct reading of the baby's length in mm. A constant pressure catch is fitted to the counter to lock the carriage automatically at the measured point when a force of 1lb (454 g) is exerted by the observer on the foot plate. This is important in eliminating one observer variable, that is pressure. The instrument is cleansed between use by an antiseptic spray. The Prematometer's dimensions are width 300 mm and length 600 mm.

In order to perform a measurement, the side door of the incubator is opened and the frame placed over the baby; the door is then closed and the measurement is made through the two side portholes. An assistant approaches the baby through the back folding door of the incubator which is held partially closed to reduce the heat loss. The assistant holds the baby's head firmly against the centre of the curved head piece ensuring that the inferior borders of the orbits lie in the same vertical plane as the external auditory meati and, at the same time, secures the infants's shoulders to the surface (Fig 2). Care is taken to ensure that the infant lies in the long axis of the instrument. The operator then fully extends the infant's right leg with the left hand and holds the foot at right angles to the surface. The mobile foot plate of the instrument is then brought towards the baby with the right index finger. It stops automatically. The measurement is then read from the number counter.

We undertook two experiments; the first experi-

ment was performed to compare the accuracy of the Prematometer with a conventional disposable paper tape measure. Four neonates were measured by two observers six times each, three times using the Prematometer and three times using the tape measure. These measurements were performed inside incubators. The technique for the disposable tape measure consisted of placing the baby supine on the tape measure with the head and shoulders held by an assistant in the manner described above. The observer then extended the right leg and held the ankle at right angles to the surface and recorded the measurement of crown to heel length from the tape measure.

The second experiment was performed to determine the precision with which crown to heel length measurements could be made inside an incubator using the Prematometer. Ten preterm babies of between 32 and 36 weeks' gestation were measured by four different observers inside incubators. Each observer took five consecutive measurements of each baby repositioning the baby after each measurement. The same observers then measured 10 babies of similar gestational ages in the same way on a table covered by a sheet in a warm environment. The results were recorded and statistical analysis performed. Analysis of variance was used for each experiment. Variation between single measurements of each observer was estimated using the residual variance. The variance components method² was used to estimate the standard deviation appropriate for comparisons between single measurements made by different observers.

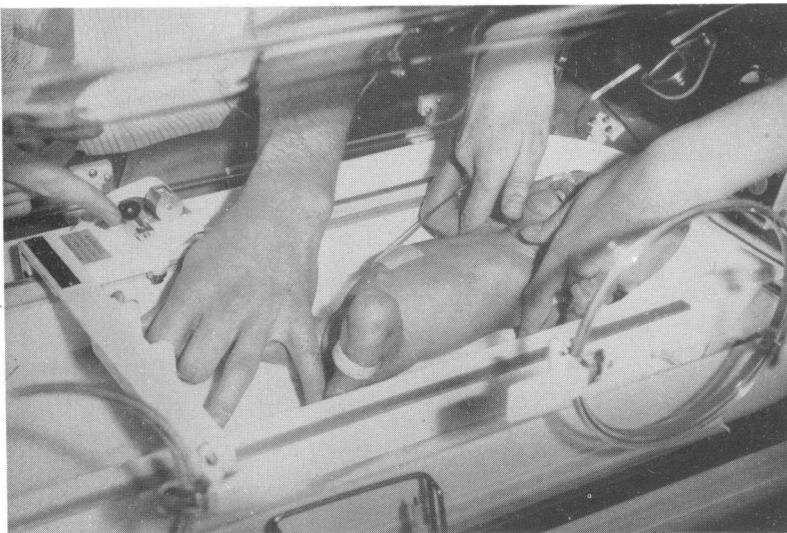


Fig. 2 *An infant being measured with the Prematometer inside an incubator.*

Results

Table 1 shows within observer standard deviations for experiment 1. Table 2 shows within observers and between observers standard deviations for experiment 2. In both respects the Prematometer gives better reproducibility than the tape measure ($P < 0.001$).

In experiment 2, within observer variation was, paradoxically, lower inside incubators than outside ($P < 0.05$), and variances found inside and outside the incubator significantly exceeded those of Davies and Holding ($P < 0.05$, < 0.001 respectively). Variation between observers followed a similar pattern.

Table 1 Comparison between tape measure and prematometer inside incubator

	Within observers SD (cm)
Tape measure	0.972
Prematometer	0.179

Table 2 Comparison of performance inside and outside incubator

	Within observers SD (cm)	Between observers SD (cm)
<i>Prematometer</i>		
Inside	0.219	0.307
Outside	0.262	0.373
<i>Neonatometer</i>		
Davies and Holding (1972) outside incubator	0.175	0.223

Discussion

Experiment 1 showed the clear advantage of the Prematometer over the tape measure. The results of experiment 2 were surprising, one would expect poorer performance within the restrictions of an incubator, and may be understood as representing reproducibility attained which may not be the best attainable. These results suggest that observers took much greater care within the incubator to compensate for the greater difficulty.

As with other anthropometric methods, careful attention to technique is required with the Prematometer if a high degree of accuracy and consistency is to be achieved. The technique is simple, however, and with practice the Prematometer can be used quickly and with ease inside an incubator by any member of medical or nursing staff.

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References

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