A technique for epiphysiodesis using a cannulated tubesaw has been developed to combine the precision of the original Phemister method with newer percutaneous methods. The approach is unilateral, and requires minimal access. Reinsertion of the removed core of bone reduces haemorrhage from the defect and augments arrest of the growth plate.

In 35 patients treated by this method predicted discrepancies of 2 to 4.5 cm were reliably reduced to 0.7 ± 0.6 cm, with no serious complications. The timing of surgery is critical, and relies upon careful monitoring of the pattern of discrepancy over several years, using clinical and radiographic measurements. Undercorrection of the disparity in three patients was the direct result of late referral.

The correction of minor discrepancies in limb length of between 2 and 4.5 cm can be achieved relatively simply by properly timed epiphysiodesis. Ideally, the velocity of growth and the patterns of discrepancy should be assessed by charting longitudinal growth in the leg or the arm. When the child is seen late, accurate charting and prediction are difficult to achieve, although the method of White and Stubbins, refined by Westh and Menelaus, usually proves to be reliable.

The method of epiphysiodesis described by Phemister in 1933 relies upon rotation of bone blocks at either side of the growth plate together with curettage. The morbidity after operation has been reduced by percutaneous techniques, although these methods are not necessarily less traumatic and require a fairly prolonged exposure to irradiation. In order to avoid incisions on both sides of the limb, a technique using a tubesaw has been developed. The preliminary results are comparable with those of the Phemister technique.

PATIENTS AND METHODS
Between 1989 and 1994, tubesaw epiphysiodesis was carried out on 46 occasions (Fig. 1). Our report describes the results at skeletal maturity in a consecutive group of 35 patients (22 boys and 13 girls) aged from 10 to 15 years (mean 13.5 years) at the time of operation. The anticipated discrepancy of leg length ranged from 2.0 to 4.5 cm (mean 3.3 ± 0.9 cm) and resulted from a number of conditions (Table I).

**Technique.** A guide pin 3.2 mm in diameter is inserted...
accurately across the growth plate using an image intensifier. The curve in the distal growth plate in the femur accommodates the pin if it enters the mid-central point of the lateral aspect. A centralising cylinder guides the hand-driven tubesaw across the physi and a core of cancellous bone and growth cartilage measuring 1 cm in diameter is removed in two or three segments (Fig. 2). After curettage of the residual anterior and posterior growth plate through the tunnel, the cylinder of bone is replaced; this augments the arrest of growth (Fig. 3) and reduces haemorrhage from the cortical defect. No more than six pulses of viewing with the image intensifier are required since the presence of growth-plate cartilage can be observed in the excised core of bone and the curetted samples. Angular deformity is avoided by engaging the opposite cortex of the bone where the exit can be palpated. The track produced by removal of the bone can be seen on radiographs.

RESULTS

After the operations, the mean residual length discrepancy at maturity was 0.7 ± 0.6 cm. In three patients the final disparity was 1.5 cm since they had been referred too late to obtain full correction. In one child slight overgrowth of the fibula has produced prominence of its head, and in two others the scar is slightly hypertrophic, but the procedure usually leaves a cosmetically satisfactory limb. Splintage is unnecessary after operation and there have been no cases of residual malalignment or overcorrection.

Epiphysiodesis was usually used to correct length in the segment of the limb in which the disparity lay. Proximal femoral shortening was managed by a contralateral distal femoral procedure and tibial arrest by a contralateral proximal tibial epiphysiodesis. When abnormalities were present in both segments simultaneous femoral and tibial epiphysiodeses were performed.

DISCUSSION

The timing of growth-plate arrest is fundamental to the equalising of discrepancy in limb length. Variations in the patterns of growth make it advisable to plot leg lengths for a minimum of three years, by annual clinical and radiographic measurements, and ideally such children should be monitored from the preschool period. By the age of 11 years, the pattern of growth is usually clear so that a projected discrepancy can be estimated. Eastwood and Cole have produced a graphic method based upon regular clinical review, with intermittent radiographic and CT assessment. Instead of presuming a linear, incremental increase in the disparity, as in the straight-line graph of Moseley or the arithmetic method of White and Stubbins, they recommend that reference slopes are plotted to determine the timing of epiphysiodesis in individual cases, with reference to the probable evolution of the discrepancy.

When the discrepancy is relatively small, diagnosis may be too late for determination of the developmental pattern. The simpler method of timing proposed by Menelaus can then be used in conjunction with the skeletal age and the Green and Anderson ‘growth-remaining’ chart. The error in this estimation is relatively small since discrepancies diagnosed late are usually small and can be reduced to less than 1 cm. Overcorrection must be avoided particularly when the shorter limb is partially paralysed.
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REFERENCES