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makes it possible to determine the combination of lengthening, shortening, and epiphysiodesies which will be needed to achieve equality of leg length.

In case of predicted length discrepancy less than 8 cm., a one stage lengthening procedure is the preferable method .

If greater discrepancy exists, one must calculate whether shortening procedure such as shortening osteotomy or epiphysiodesis will be advantageous and how many centimeters can be obtained by shortening .

In case of P.F.F.D. with a predicted limb length deficit more than 10 cm., lengthening of the lower leg should be performed . It is advisable to lengthen the tibia (which usually is also shortened) 2-4 cm. more than the predicted length of the normal side, accepting the disadvantage of having knees at different levels . The remaining limb length discrepancy of the femur then should be lengthened .

If after correction of the hip deformity, epiphysiodesis of distal femur of the contralateral side, an overlengthening of the tibia, a discrepancy of more than 8 cm remains, femoral lengthening should be performed in two stages .

Choice of the lengthening technique :-

Four different lengthening techniques were used :-

(1) the original Wagner technique;

(2) a modified Wagner technique;

(3) the Orthofix technique, with callus distraction, and

(4) the Ilizarov technique with callus distraction or distraction epiphysiolysis .

Wagner technique is no longer recommended for its high rate of complications .

A much better outcome was obtained with the use of Ilizarov and Orthofix techniques .

If we can assume that the hip and knee are stable, an Orthofix device is preferable .

If not, if the hip joint is unstable or there is a high risk of dislocation, the Ilizarov device is preferable ***(Grill, Dungl, Steinwender and Hosny, 1993)*** .

Advantages of the Orthofix lengthener :-

(1) The screws and the external frame form a very rigid system . This stability significantly reduces osteolysis and osteitis and apparantly facilitates direct ossification of the fibrous tissue .

(2) The patient can bear weight from the beginning of treatment .

(3) Because the device is not fitted with articulated clamps, loss of axial alignment does not occur .

(4) Axial and rotational corrections between the segments can be made at the time of application .

(5) The telescopic feature of the fixator body permits axial dynamic compression during the ossification stage . This process appears to accelerate the corticalization of the periosteal bone in the lengthend segment .

(6) The unilateral configuration of the fixator greatly reduces the risk of neurovascular injury .

(7) The device is also more comfortable to the patient than are bilateral frames ***(Aldegheri et al., 1989)*** .

Advantage of the Ilizarov technique :-

The advantage of Ilizarov method is that it allows articulation of either hip or knee ***(Gill, Dungl, Steinwender and Hosny, 1993)***.

Problems and complications of lengthening :-

Kawamura et al., (1968) and **Coleman and Stevens (1978)** stated that patients with lengthening in excess of 15% of the initial bone length are likely to develop a much higher incidence of complications . Even so,

significant complications occured at about the same rate for patients with 20% lengthening or more .

Thus, the amount or percentage of lengthening was not correlated with the development of complications .

A much higher rate of complications occured in congenitally shortened cases than in acquired shortened cases .

Wagner and **Coleman and Stevens (1978)** made a distinction between **complications**, including infection, fracture and deformity and **problems** including delayed union, non union,restriction of joint motion, paresis and psychiatric problems .

Problems are stated as anticipated occurences, while complications are stated as unanticepated adverse occurences .

(1) Pin tract infection .

(2) Deep infection .

(3) Fracture of the lengthened zone .

(4) Malunion, delayed union and non union .

Non unions are treated by plating and grafting ***(Chandler et al., 1978)*** .

(5) Subluxation and dislocation of the knee ***(Jones and Moseley, 1985)*** .

Coleman and **Stevens (1978)**, warned of possible anteroposterior instability in cases of congenitally short femur and stressed the importance of periodic lateral knee roentgenograms while lengthening is being instituted . Furthermore, these authors emphasized that knee motion should not be aborted and physical therapy applied when knee extension lacks 10° or more or when knee flexion does not exceed 60° ***(Chandler et al., 1987)*** .

(6) Subluxation and dislocation of the hip :-

treated at the end of the lengthening procedure by extra-articular lysis and varus osteotomy of the femur ***(Aldegheri et al., 1989)*** .

(7) Neurovascular injury .

(8) Joint contracture *(Chandler et al., 1987)*.

(9) Early fusion of the osteotomy :-

treated in most cases by non surgical manipulation under general anaesthesia .

(10) Psychological troubles *(Aldegheri et al., 1989)*.

Out of 5I patients who underwent different lengthening procedures, **Grill, Dungl, Steinwender** and **Hosny (1993)** reported the following complications : 42 had pin tract infection, five had a deep infection, 25 had femoral fractures, two had peroneal nerve palsy, nine had knee subluxation (or dislocation), and two had hip dislocation *(Grill, Dungl, Steinwender, and Hosny, 1993)*.

- Bone Shortening :-

In cases of leg length discrepancy exceeding 2 cm, operative equalization is indicated . Unlike elongation, which carries more risk and entails a longer healing period, limb shortening is a minor operative intervention .

The disadvantages are that it has to be performed on the "sound" side, and the resultant stature of the patient will be smaller .

During the growth period, shortening also can be achieved by epiphysiodesis, but the outcome is unpredictable *(Szepesi et al., 1990)*.

Epiphysiodesis of the longer extremity is not an option after skeletal maturity has been reached *(Blair et al., 1989)*.

At the present time, the clinical results of epiphysiodesis may be compromised by any uncertainty or inaccuracy in predicting the growth of long bones *(Moseley, 1977)*.

Therefore, operative shortening of bones after closure of the growth plates is becoming a more popular method . It is more advantageous to shorten the femur than the tibia . Up to 6 or 7 cm of the femur can be

shortened without functional disturbance, whereas only 3cm of tibia can be shortened, when determining the site of the operation, the location of the shortening has to be taken into consideration .

Types of shortening :-

(1) Proximal femoral metaphyseal shortening :-

done by subtrochanteric femoral osteotomy with fixation of bone fragments with the blade plate . It is a simple and safe method .

(2) Distal femoral metaphyseal shortening :-

done by supracondylar osteotomy .

Proximal metaphyseal has fewer complications than distal because of the proximity of the distal osteotomy to the knee joint, so, it is only indicated in few cases ***(Szepesi et al., 1990)*** .

(3) Closed femoral diaphyseal shortening :-

The patients who were considered for closed shortening of the femur were skeletally mature and had a limb length inequality of at least two centimeters and, ideally, not more than five to six centimeters .

Additionally, a stable hip and knee and normal longitudinal alignment of the limb were prerequesites . Preoperatively, the amount of femoral shortening that was necessary to level the pelvis was determined radiographically by balancing the pelvis with calibrated lifts under the shorter extremity . All procedures were performed with an intramedullary cam saw and insertion of an intramedullary rod through a gluteal incision ***(Blair et al., 1989)*** .