
BONE LENGTHENING BY " Z " CORTICOTOMY

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Abstract

This is a prospective study done on 40 patients presented with lower limb length discrepancies between March 1993 and September 2003. After correction of apparent shortening by correcting associated deformities like flexion deformities of the knee, bone lengthening for the remaining true shortening ranging from 3cm – 10.5 cm was done. The "Z" corticotomy involves cutting the cortex in Z manner with preservation of the periosteum and medullar cavity as much as possible, followed by manual distraction.

The advantages of Z corticotomy in comparison to transverse corticotomy or transverse osteotomy are; That there is no need for internal fixation by plate and screws, no need for bone graft to enhance osteogenesis, the chances of mal-alignment of the distracted fragments are minimal as the limbs of the Z – corticotomy maintaining the alignment during the distraction, and the stability of the external fixate is very important for the extent of ontogenesis but this was compensated by doing Z corticotomy.

Introduction

Limb length discrepancy has two concerns, cosmetic and functional concerns. The leg gait is awkward, increases energy expenditure because of the excessive vertical rise and fall of the pelvis and may result in backache from long standing significant discrepancies¹. Higher reported incidence of osteoarthritis on the longer side due to pelvic obliquity leading to uncovering of the femoral head².

Commonest causes are: trauma, paralytic conditions like poliomyelitis, cerebral palsy, infection, tumour and tumour-like

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conditions, idiopathic unilateral hypoplasia and hyperplasia growth of the long bones may be affected asymmetrically in some conditions like juvenile rheumatoid arthritis.

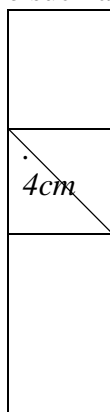
The simplest way of measuring limb length discrepancy is to place wooden blocks of known heights under the short leg till the pelvis is level owever asymmetrical pelvic development or pelvic obliquity may cause miscalculation³. By using tape measure from anterior superior iliac spine to the medial malleolus is another method but this does not include foot height.

Roentgenographic technique by standing orthoroentgenogram and Scano-gram are two imaging techniques.

Treatment of limb length discrepancy can be done by: shoe rising of the shorter limb if the discrepancy is 2.5 cm, epiphysiodesis of the longer limb, shortening of the long leg and lengthening of the short leg. The program requires patient and family full committed to maximal participation in an extend project. The patient and his parent benefit from meeting other patients in various stages of lengthening.

Historical development of bone lengthening: In 1905 Codivilia performed limb lengthening for the first time following intraoperative osteotomy, he distracted the bone fragments using powerful tension exerted via nails in the bone, he minted the gap by incorporating the nail in the plaster. Wagner in 1977 performed open osteotomy, immediate diastasis 1 mm per day of lengthening followed by plate fixation and bone grafting⁶. DeBastni in 1987 applied similar but more versatile fixator (orthofix). In the early 1950 Gavril Lizarove devised a thin wire circular external fixator, he performed percutaneous tibial corticotomy.

In children, the fixator is worn approximately one month for each centimeter of lengthening, in adults about 1.5 months for each centimeter of lengthening. This lengthening period of fixator wear is one of the majour disadvantages of Ilizarove techniques⁴. Paley classified complications of limb lengthening as: Pin tract infection, obstacles which needs a secondary procedure such as repeat corticotomy for



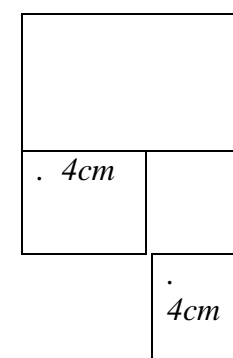
permanent consolidation of the lengthening gap neither problems nor obstacles necessary prevent a good result. Complications like residual equines contracture and knee stiffness. Under optimal stable conditions, bone is formed via intramembranous ossification, while in unstable environment bone forms via enchondral ossification or in an extremely unstable environment, pseudoarthrosis may occur⁵.

PATIENTS & METHODS

This is a prospective study done on 40 patients, during March 1993–September 2003. They were treated in Hawler and Sulaimania teaching hospitals. The true shortening was ranging from 3.0 cm to 10.5 cm

Operative techniques:

For femoral lengthening under general anaesthesia in supine position the available external fixator at that time which available even for fixation of fracture bone with unilateral fixator is used through lateral approach Z corticotomy done in femur below the level of lesser trochanter. The length of limb of Z plasty to be half of the desired elongation, e.g. if the desired length is 8 cm, it is better that the length of each limb of the Z plasty to be 4 cm as shown in figure 1.



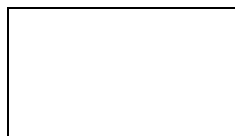


Fig.1

The cortex of femur is exposed, multiple holes are done in Z shaped manner by using shanz pin on T shape handle , then using 5 mm osteotome and hammer to join the holes and complete the corticotomy, then external fixator was applied. Three days post-operatively distraction is started manually 1mm daily. For tibial elongation we used the bilateral fixator, the lower end of fibula is fixed to the lower end of tibia above the level of malleoli by using a single screw, 1.5 cm of the fibula is excised at the level of the diaphysis of the tibia with division of the interosseous membrane. The corticotomy done in the metaphysis of

the tibia, in Z shaped manner, in a similar way which was mentioned above for the femur. Three days postoperatively distraction is started 1mm daily.

Results

Forty cases were included in this study 27 of them were males and 13 were females as shown in fig.2. Tibia was the commonest site of lengthening as demonstrated in fig.3. Figure 4 showed that poliomyelitis is the most common cause of shortening. Figure 5 showed that age 11-20 is the most common one. Figure 6 demonstrated that pin tract infection and knee stiffness are the most common complications.

Fig. 2: Sex relation

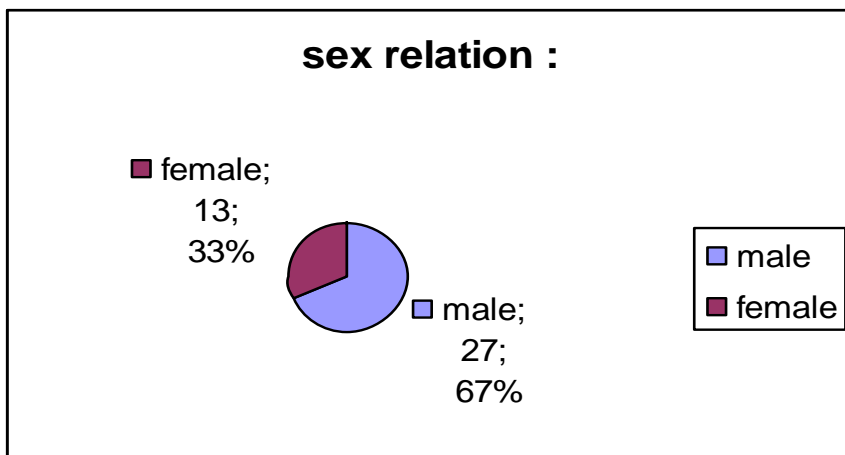


Fig.3: Sites of lengthened bone

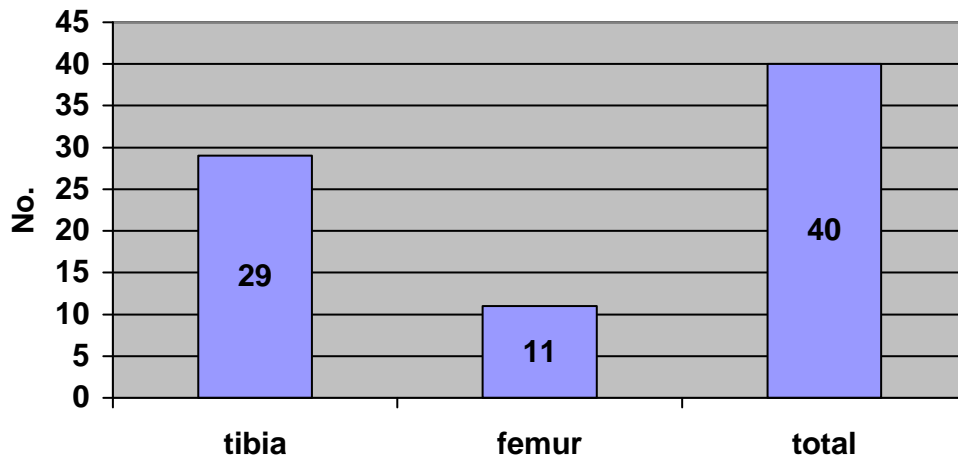


Fig.4: The causes of shortening

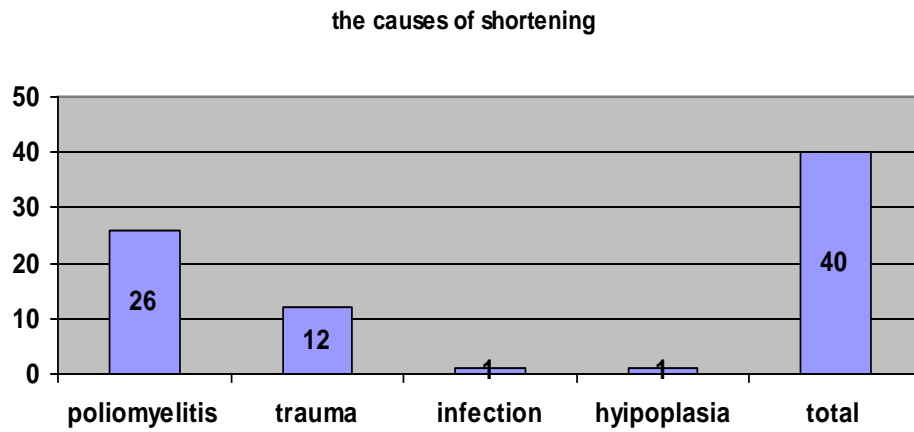


Fig.5: age grouping

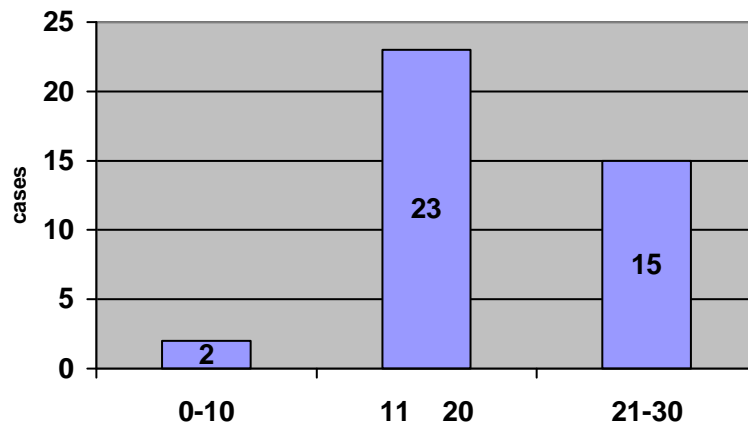
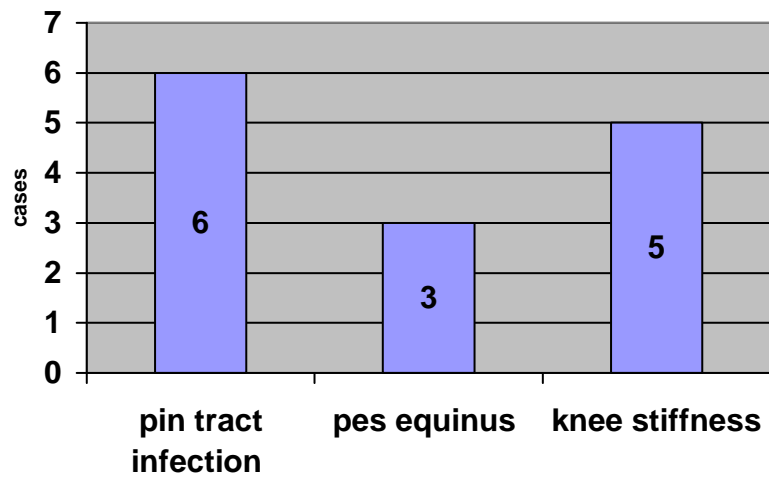


Fig.6: Complications



The following pictures showed the procedure of lengthening on a poliomyelitic patient after correction of left hip flexion deformity; the bone lengthening device was applied with 8 cm leg shortening.



we can see now in the following two pictures the same patient with both legs are equal in length.



The next two pictures showed the same patient after removal of the device, now he can walk without support.



The next radiographs show the patient with his bones are well corticalized.



Discussion

Bone lengthening is a surgical procedure used to lengthen short extremity (i.e. arm or leg) to achieve an equal length with opposite arm or leg⁶. Limb lengthening should not be undertaken lightly as this procedure might associated with considerable complications⁷.

Bone lengthening usually done by corticotomy and gradual callus distraction (callotasis) and typically lengthening of 15% or about 6cm is recommended⁴.

The corticotomy may be is transverse, oblique or Z-shaped. Numerous fixation devices are available, such as ring fixator with fine wires, monolateral fixator with half pins, hybrid frame, or intramedullary nail⁸

Lengthening of tibia is preferred to femoral lengthening which is more difficult procedure with higher complications like knee joint contracture (in this study 29 tibiae were lengthened) However, femoral lengthening is more reliable to achieve lower limbs which are as symmetrical as possible with the knees at same levels, in this study 11 femora were lengthened.

In this study monolateral external fixator was used because it is easier to apply and better tolerated by the patients.

The disadvantage of monolateral fixation device is angular deformity due to the cantilever effect on the pins .

No such angular deformity was observed in this study because the limbs of Z-corticotomy prevent mal-alignment of the distracted segments. Z-manner corticotomy provide wider bony area which is covered by osteoblast that can result in more intense osteogenesis, this together with the preservation of medullary canal circulation offered good healing of lengthened bone and eliminate the need for bone graft and plating as often used in Wagener technique of lengthening⁹ the rapid osteogenesis following distraction shortened the average time for wearing of the external fixator which was one month for each centimeter, in comparison to 1.5 month for each centimeter in Ilizarov procedure of lengthening^{10,11}. Pin tract infection was common followed by knee joint stiffness and pes equines, these figures are similar to what mentioned in other reviewed studies¹.

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