The results of limb lengthening, correction of limb deformities and solving of bone loss, by the use of Mitkovic external fixation system and minimally invasive technique on the series of 96 operations in 89 patients are shown. Only lower extremities were included in this series. The advantages of this external fixation system in comparison to other systems are pointed out. The main advantages are the optimal biomechanical conditions including unilateral but 3-dimensional frame, which provides conditions very similar to natural biomechanical features of the human long bones, simplicity of application and low cost. The received result was excellent or very good in 98.4%. Maximal limb lengthening was 18 cm (at the same time in the femur and the tibia). Angular deformity correction is extremely simplified with minimized possibility of complications. The frame for bone transport is very simple. It can be concluded that presented methods are suitable for routine use. 

Key words: lower limbs, deformity, lengthening, external fixator Mitkovic

INTRODUCTION

Deformities of extremities are common both as congenital and as acquired. Their treatment remains a challenge for orthopaedic surgeons. In the past, attempts to solve deformities such as bigger shortening or shortening combined with angular or torsional deformity were often disappointing. Development of external fixation brought new possibilities and satisfaction for patients and for surgeons. The biggest progress has been made by Professor G.A. Ilizarov who devoted all his life to limb lengthening and deformity correction. He invented many methods using his ring fixator. One of his biggest inventions is related to corticotomy and callus distraction. The goal of this paper is to present a new, simpler method of callus distraction in achieving limb lengthening, deformities correction, and bone defect solving.

MATERIAL AND METHODS

A series of 96 operations in 89 patients treated in Al Salam hospital in Kuwait and in Orthopaedic Clinic of Clinical Centre Nis during the 1995-2003 period has been analysed. Average age was 26 years (5-72). There were 35 female and 52 male patients. Lengthening has been performed 44 times (30 operations on the tibia and 14 on the femur), correction of angular deformity has been performed 44 times (27 times on the proximal tibia, 4 times on the distal tibia, 1 time on the distal femur) and solving of bone defect 9 times. Bone defects have been posttraumatic with 3-8cm defect of the tibia (6 operations) and one on the femur with defect of 5cm. Average follow up was 27 months (from 8 months to 6 years). Operations on the upper extremities have not been included in this series. Mitkovic external fixation system has been used for all lengthening, angular deformities correction and bone defect solving. For lengthening, telescopic bar (including specially developed compression-distraction device) has been used; for angular deformities correction, telescopic bar with special joints; and for solving of bone defect problem, simple bar with compression-distraction device. Technique of operation consists of introduction of 2 pins in proximal and 2 in distal fragment in convergent orientation (for limb lengthening 3 pins are introduced proximally and 3 distally). All pins were 6mm in diameter. After that corticotomy (for limb lengthening and for solving of bone defect called "sliding graft") or haemiacorticotomy (for angular deformity correction) is performed. Corticotomy or haemiacorticotomy (special kind of the bone cutting) is performed minimally invasively, through 2-3cm long incisions. Then the frame is set. For angular deformity correction and "sliding graft", the fibula has not been osteotomised. A patient is hospitalised 1-3 days only. Dis-
traction starts 7-10 days after operation in the range of 1mm per day (it is recommended half turning to be performed in the morning and half in the evening). Patient is allowed to walk the same day after operation, but using crutches, with weight bearing. When distraction starts, weight bearing more than 20% is not recommended. After finishing of distraction and correction, it is recommended to the patient to increase weight bearing until 100% is reached (within next 3-4 weeks), but to walk with external fixation 1.5 months more. In limb lengthening, full corticotomy has been made, whereas in angular deformity correction, only 60% of the bone circumference (in metaphysal area). Removing of the fixator is always performed in outpatient clinic without anaesthesia.

RESULTS

All operations and postoperative procedures have been successful. The maximal distraction has been 18 cm (performed simultaneously in the femur and the tibia). Average lengthening was 4cm. Fig. 1 shows 5.5cm lengthening in a 46 years old male. In patients with bilateral angular deformities we prefer both legs to be operated at the same time (Figs. 2, 3). It is allowed to these patients to walk with full weight bearing during the treatment, but they are recommended to use crutches as protection for the first 3 weeks. There were no complications it terms of pin track or other infection, joint stiffness, neurovascular complications, delayed union or non-union. The received result was excellent or very good in 98.4%.

DISCUSSION

Correction of varus or valgus deformity in the knee ordinarily involves high tibial open osteotomy and internal fixation. This procedure is often followed by complications. The most frequent complications are related to extensive surgical procedure followed by full cutting of the proximal tibia and the fibula, peroneal nerve palsy, skin problem and infection. Using internal fixation requires another operation for removing of the plates and screws. When using the minimally invasive technique, as suggested here, the removal of the external fixator is performed in outpatient clinics without anaesthesia, another operation being not required, therefore. The main advantages of Mitkovic external fixation system in comparison to the two most known systems - Ilizarov and Orthofix - are the following: 1. It is not necessary for the pins to penetrate both sides of extremity (as in Ilizarov system), thus avoiding unsafe areas and danger of complications; 2. There is no ring, which limits knee motions and leads in knee stiffness, near to the knee joint; 3. The system biomechanics are very similar to the natural biomechanics of the long bones because it is 3-dimensional, which is not the case with Orthofix, which is 2-dimensional; and 4. Operation and postoperative treatment are extremely simplified allowing “free hand” technique of each pin insertion and easy setting of the plane of correction regardless of the position of the pins.

FIGURE 1
X-RAYS OF A 46 YEARS OLD MAN WITH 5.5CM SHORTER RIGHT LEG. X-RAYS IN 2 DIRECTIONS DURING THE 4 STEPS OF LENGTHENING ARE SHOWN: A. ONE DAY AFTER OPERATION (BEFORE STARTING THE LENGTHENING), B. SEVEN DAYS AFTER LENGTHENING BEGAN, C. FORTY DAYS AFTER LENGTHENING BEGAN (THE DISTRACTED CALLUS BECOMES VISIBLE) AND D. THE END RESULT AT THE SAME DAY AFTER EXTERNAL FIXATOR REMOVAL.

FIGURE 2
A) PICTURE OF A PATIENT BEFORE OPERATION, B) THE SAME PATIENT AFTER CORRECTION HAS BEEN ACHIEVED AND C) PICTURE OF THE SAME PATIENT AFTER EXTERNAL FIXATOR HAS BEEN REMOVED (65 DAYS AFTER THE OPERATION)

Very big progress has been made in solving the bone loss problem during the past 10 years. The Mitkovic system enables the procedure to be very simple so that it is not necessary to have either long education program or expensive devices. The first author has recently developed a new system for limb lengthening and angular deformity correction, which is fully implantable, also using remote control, but it is not described in this article. Conclusion According to the obtained results, it can be concluded that Mitkovic external fixation provides easy technique for routine use in limb lengthening, angular deformity correction and solving problems of bone defects. This unilateral, 3-dimensional system provides biomechanical conditions similar to the biomechanical features of the long bones.
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BIBLIOGRAPHY


Figure 3

X-ray of the patient from Fig. 2 at the end of the correction. The opening of the bone on the cut place, which is filled with new-formed callus, and bending on remaining part of the bone, is visible. As the bone is not cut fully, the patient is allowed to walk with weight bearing from the beginning.