Ilizarov External Fixator in The Management of Fractures of Femur

Muhammad Inam[1], Mohammad Saeed[2], Sanaullah[3], Imran Khan[4], Alamzeb Durrani[5], Mohammad Arif[6]

ABSTRACT

Objective: To evaluate the outcome of the Ilizarov technique in open fractures and nonunion of the femur.

Material and Method: This multicenter case series study was performed on 27 consecutive patients at Orthopedic Unitsof Khyber Girls Medical College, Postgraduate Medical Institute Hayatabad Medical Complex and Akbar Medical Center Peshawar from January 2012 to February 2015. Patients of both gender with age between 15 to 72 years, having fresh open fractures and nonunion (clean and infected nonunion) in femur were included in the study. Ilizarov fixator of hybrid type were used in all cases. Bone healing and the functional results were assessed according to criteria given by ASAMI (Association for the study and application of the method of Ilizarov).

Results: Out of 27 patients, 19 (70.4%) were male and 08(29.6%) were female. Mean age was 40 years. Thirteen(48.1%) patients had infected non-union 04 (14.8%) aseptic non union and 10(37%) were fresh open fractures. Segment Transport was done in 13(48.1%) patients while compression/distraction was done in 20(74.1%) patients. Bone result was excellent in 14 (51.9%), good in 08 (29.6%) and fair in 05 (18.5%)patients while functional results were excellent in 8 (29.6%), good in 11 (40.7%), fair in 06 (22.2%) and poor in 02 (7.4%) patients.

Conclusion: Ilizarov ring fixator is excellent treatment modality for femoral non-union with a defect, regarding bone union, deformity correction, infection eradication, limb length achievement and limb function.

Key Words: Femur, Fracture, Ilizarov Technique, Osteogenesis, Distraction

INTRODUCTION

The increasing incidence of high-velocity trauma with massive damage to bone and soft tissues posesa major challenge to the operating surgeon. In femoral fractures bone loss and associated contamination in open high-energy fractures, devitalisation of bone fragments from extensive surgical exposure[1] and the use of bulky internal fixation may result in nonunion which may further be complicated by infection. A short distal fragment, poor bone quality and compromised soft tissues are the other associated problems. Union may be achieved with deformity and leg-length discrepancy leading to posttraumatic Osteoarthritis and stiffness of the knee.[2,] [3]This may necessitate arthrodesis as a salvage procedure,[4] and in some cases amputation may be required. Conventional methods for treating infected nonunion or fresh open fractures of the femur includes external fixation, drainage, sequestrectomies, and massive cancellous bonegrafting.[5,6] They are often unsuccessful due to limitations including: quantity of graft available, donor-site morbidity, poor vascularity, persistence of infection, and extensive bone defects and deformity. External fixation with debridement and massive bone grafting for infected nonunion of the femur has also been reported.[7,8] Microvascular composite tissue transfer has given promising results in the tibia and femur.[9,10] Nonetheless, it has limitations in regaining length and correcting deformity and requires expertise. Electrical stimulation has been used in osteogenesis with or without bone grafting in delayed union or nonunion.[11] The results are uniformly poor in patients with coexisting infection and fracture instability.[12] All these modes of treatment are inadequate for achieving limb length equality and deformity correction. In 1951, Ilizarov began to use distraction osteogenesis to treat acute fractures treat fractures and associated complications, like nonunion, chronic osteomyelitis,

Department of orthopedic Gaju Khan Medical College Swabi, Khyber Girls Medical College and Postgraduate Medical Institute Hayatabad Medical Complex Peshawar

Correspondence: Dr Muhammad Inam, Email: dr_mohammadinam@yahoo.co.uk

shortened extremity, joint contracture, and deformity. The Ilizarov technique for infected nonunion consists of removal of infected tissues and bone, stabilization with ring fixators, and regeneration of intercalary bone defect by distraction osteogenesis, compression at the nonunion site, and correction of the deformity. The regenerated bone restores length and eliminates infection. Disuse osteoporosis and soft-tissue atrophy is minimized due to early functional loading of the limb.[13]TheIlizarov technique for complex nonunion has a high rate of success in achievingunion and eradicating infection, bone loss and malalignment. It has producedexcellent results where the existing methods have failed to achieve results.[14]

Our province is more prone to open fractures due to anti personal mines and bomb blast injuries. These patients with bomb blast injuries needs such a treatment that is once for all and need quick recovery to start their job. Keeping in mind these fact we have conducted this study with the objective to evaluate the outcome of the Ilizarov technique in open fractures and nonunion of the femur.

MATERIAL AND METHOD

This multicenter case series study was performed on 27 consecutive patients at Orthopedic Units of Khyber Girls Medical College, Postgraduate Medical Institute Hayatabad Medical Complex and Akbar Medical Center Peshawar from January 2012 to February 2015. At presentation, a full history was obtained for details of the initial injury and previous surgical interventions. The patients were examined for presence of shortening, neurovascular deficiency, condition of soft tissue, active infection if any, and function of relevant joints was documented. Radiological evaluation was done to determine the fracture pattern, plane of deformity, alignment and to look for signs of osteomyelitis. Patients were informed about the approximate duration of treatment and the associated complications prior to surgery. Patients of both gender with age between 15 to 72 years, having fresh open fractures and nonunion (clean and infected nonunion) in femur were included in the study. Ilizarov fixators of hybrid type were used in all cases. All the procedures were done under general or spinal anesthesia with antibiotic prophylaxis where indicated. Debridement and extensive wound wash was done in all infected cases. Antibiotic protocol was followed according to culture and sensitivity when required. Physical therapy was continued throughout the treatment duration and pin-site dressings were changed daily. All patients were followed up regularly in the outpatient department and assessed for any infection, loosening of wires, for progress of bone transport, formation of regenerate in radiographs, docking site problems, and neurovascular deficit. Radiographs were taken every 4 weeks until docking and then at 6 weeks interval till consolidation and frame removal. Complications like pin tract infections, wire loosening and poor regenerate consolidation were managed on an outpatient basis but severe pin tract sepsis, major frame reconstruction for malalignment, change of wires/pins, and bone grafting required short periods of hospital stay. Once docking was achieved, the frame was retained at least until fracture union and adequate consolidation of the regenerate. Radiological healing was considered when there was bridging callus at least in 3 of 4 cortices. Once radiological healing was achieved, the connecting rods were loosened (dynamization of frame) and the patient allowed weight bearing on the extremity. If the patient could tolerate weight bearing, the frame was removed and the limb protected in a functional brace for a further period equal to the time from application of frame to its removal. Bone healing and the functional results were assessed according to criteria given by ASAMI (Association for the study and application of the method of Ilizarov). Bone healing was evaluated based on union, infection, deformity, and limb length discrepancy (table I) and classified as excellent, good, fair and poor. The functional result was evaluated according to 5 criteria which include limp, range of motion ofadjacent joints, sympathetic dystrophy, and return to activity, and classified as excellent, good, fair and poor.

RESULTS

Out of 27 patients, 19 (70.4%) were male and 08(29.6%) were female. minimum age was 15year, maximum 72 and mean age was 40 years (Std Deviation 15.351). Thirteen(48.1%) patients had infected non-union 04 (14.8%) aseptic non union and 10(37%) were fresh open fractures. The cause of initial trauma was road traffic accident in 14 (51.9%) patients, firearm injuries in 07 (25.9%) patients, bomb blast injuries in 03(11.1%) patients and fall in 03 (11.1%) patients.

A bifocal compression distraction technique (compression of the nonunion with distraction at the corticotomy-Segment Transport) was used in 13(48.1%) patients. Monofocal treatment (simple stabilisation of

the nonunion with compression and stimulation of union by distraction) was used in 20(74.1%) patients.

Bone result was excellent in 14 (51.9%), good in 08 (29.6%)and fair in 05 (18.5%)patients (Figure 1-4) while functional results were excellent in 8 (29.6%), good in 11 (40.7%), fair in 06 (22.2%) and poor in 02 (7.4%) patients (Figure 2).There was no case of late osteomyelitis. Limb length inequality was observed in 202 (7.4%) patients and maximum discrepancy was 04 Centimeter (cm) while25(92.6%) patients had noshortening. The average bone length achieved was 3.5 cm (3-9 cm). The total duration of treatment was an average of 6.5 months (5-10 months).

Table 1: Statistics

		Age of the Patient	Number of Previous Operations
N	Valid	27	27
	Missing	0	0
Mean		40.89	1.48
Median		40.00	1.00
Mode		50	1
Std. Deviation		15.351	.700
Minimum		15	1
Maximum		72	3

Gender of Patients					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Female	8	29.6	29.6	29.6
	Male	19	70.4	70.4	100.0
	Total	27	100.0	100.0	

Table 2: Cause of Injury

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Bomb Blast Injury	3	11.1	11.1	11.1
	Fall	3	11.1	11.1	22.2
	Fire Arm Injury	7	25.9	25.9	48.1
	Road Traffic Accident	14	51.9	51.9	100.0
	Total	27	100.0	100.0	

Table 3: Type Of Fracture

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Aseptic Nonunion	4	14.8	14.8	14.8
	Infected non union	13	48.1	48.1	63.0
	Fresh Open Fractures	10	37.0	37.0	100.0
	Total	27	100.0	100.0	

ASAMI Scoring system	
Bone Results	
Excellent	Union, no infection, deformity <7, limb-length discrepancy <2.5 cm,

Good	Union + any two of the following: Absence of infection, <7 deformity and limb-length inequality of <2.5 cm.
Fair	Union + only one of the following: Absence of infection, deformity <7 and limb-length inequality <2.5 cm.
Poor	Non-union/re-fracture/union + infection + deformity >7 + limb-length inequality >2.5 cm.
Functional Results	
Excellent	Active, no limp, minimum stiffness (loss of <15 knee extension/<15 dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), insignificant pain.
Good	Active, with one or two of the following: Limp, stiffness, RSD, significant pain.
Fair	Active, with three or all of the following: Limp, stiffness, RSD, significant pain.
Poor	Inactive (unemployment or inability to return to daily activities because of injury).

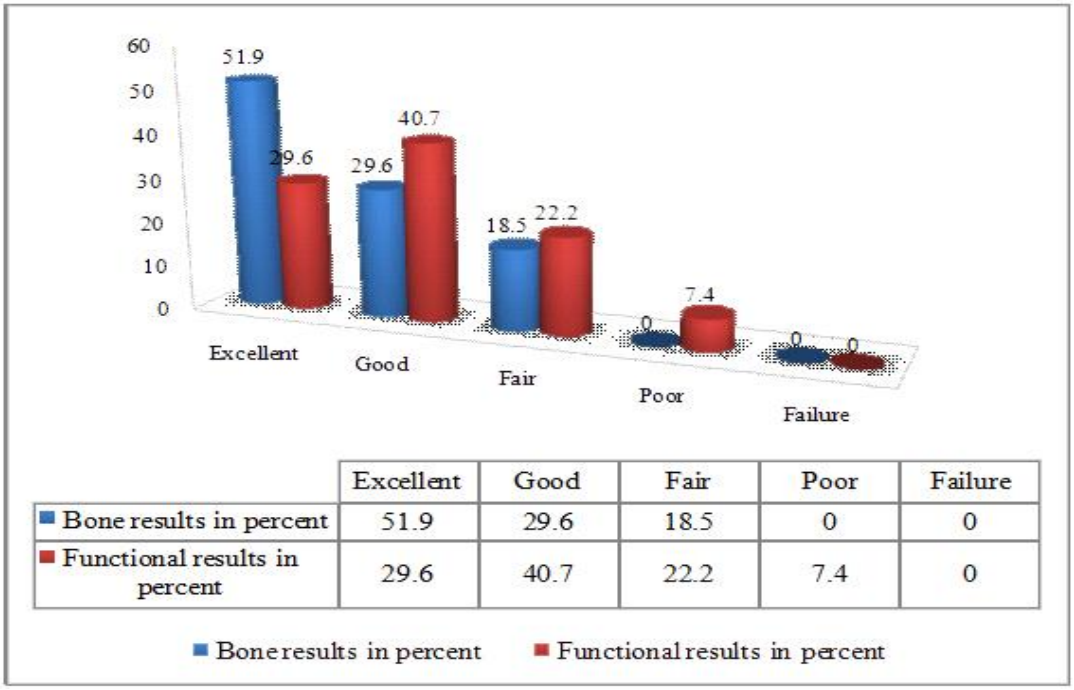


Figure 1:

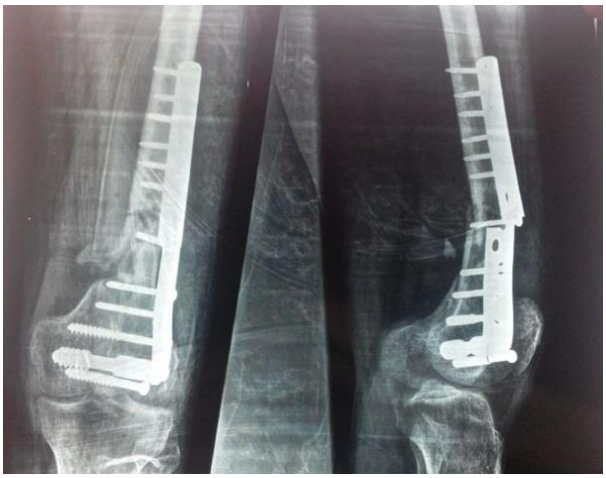
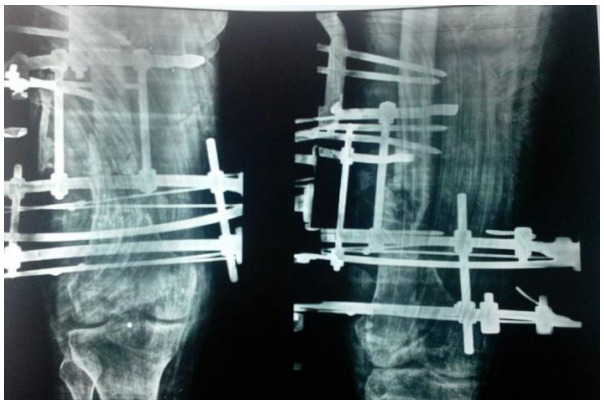


Figure 1: X Ray Implant Failure



Bone and Functional results in open fractures and infected nonunion of the femur (n=27)

Figure 2: Pos op X Ray of Ilizarov Fixator

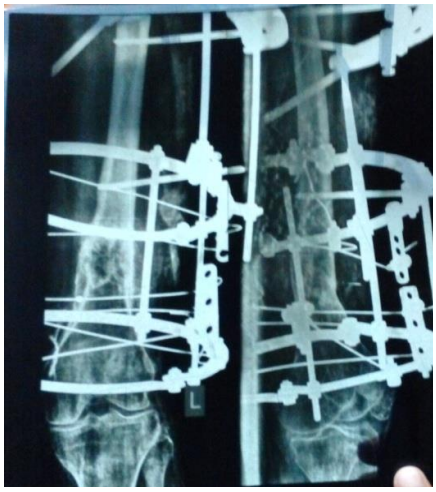


Figure 3: After three months of Ilizarov

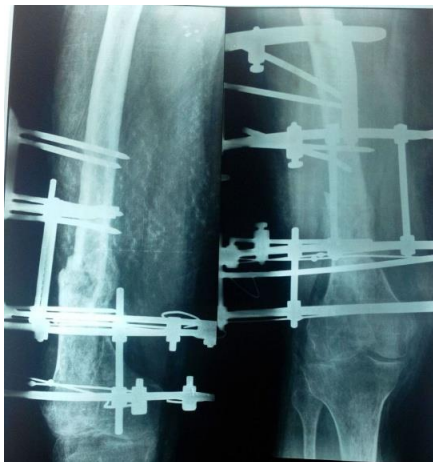


Figure 4: After 4.5 months of Ilizarov (at the time of removal)

DISCUSSION

The results of conventional treatment of fresh open fractures of femur with bone loss and infected nonunion of the femur are poor.[14] The Ilizarov technique is a salvage procedure for these difficulties as proved by our results. According to Ilizarov, gradual traction on living tissues creates stress that stimulates and maintains regeneration and active growth of tissues (bone, muscle, fascia, tendon, nerve, vessels, skin and its appendages.[15] Bone loss at presentation or in setting of established non union is a major problem for orthopedic surgeon and can be addressed in many ways. Cierny et al [15] compared the results of treating segmental tibial defects using massiveautologous bone graft and Ilizarov bone transport and found bone transport to be superior in terms of bone and functional results. Astudy by Song et al[16]compared internal bone transport and use of vascularized fibular grafts for femoral defects and found internal bone transport to have better bone results and lesser limb length discrepancy than vascularized fibular grafts, which were associated with a high incidence of vascular failure. In complicated femoral fractures particularly chronic osteomyelitis and larger bone defects, sometime the surgeon faces the dilemma of offering limb salvage or amputation to such patients[17]. We believe that all such patients who have a sensate foot and are willing to participate in the long rehabilitation program should be offered limb salvage rather than amputation. All patients in our series opted for limb salvage. The important part of a successful Ilizarov treatment is active involvement and participation of a patient regarding the daily dressing and adjustment of Ilizarov and exercises the limb and joints[18].

In our series we treated 20(74.1%) patients by unifocal distraction osteogenesis, there were no neurovascular complication, axial deviation or need for bone grafting. Union was achieved in all patients.

Once docking has been achieved, several studies now recommend proceeding with early bone grafting to decrease the fixator time [19]. As the leading edge of the intercalary fragment is avascular, which adds to a high possibility of soft tissue interposition, union can be delayed unless the sclerotic margins are trimmed and interposition removed[20]. We did early freshening of fracture margins with drilling and acute compression when docking is achieved. Cattaneo et al[21]reported that circular external fixation using theIlizarov apparatus combined with internal bone transport or compression-distraction techniques were used to treat 28 patients with infected nonunion or segmental bone loss of the tibia. In all patients their infected extremities healed without the addition of cancellous bone graft, microvascular fibular, or soft -tissue grafting. Barbarossa et al[22] described 30patients with chronic post-traumatic osteomyelitisand infected nonunion with bone defects of thefemur, none of whom underwent bone grafts at the docking site; no nonunion occurred. Dendrinos et al[23] treated defects of the tibia in 28 patients usingthe Ilizarov bone transport method and compressionat the docking site for bone union. Bone grafts were required in only 3 patients. Kuftiryev and Meshkov, according to Paley [24], reported 147 bridgings in 154 bone defects of femoralbone, with a failure rate of 4.5%, and elimination of bone inflammation in 41 out of 45 cases (91%).Urazgil'deev

et al[25] have recently published the results on 30 patients with infected non-union of the femur, with infection eradication rate of 95.9%.All our patients were operated on several times before they underwent treatment by the Ilizarov technique. Bone healing and functional results as assessed by ASAMI criteria were not well correlated. The functional results, as a rule, were poorer. The functional result depends primarily on the existing damage of nerves, muscles, vessels, joints, and, to a lesser extent, bones.

CONCLUSION

Ilizarov ring fixator is excellent treatment modality for femoral non-union with a defect, regarding bone union, deformity correction, infection eradication, limb length achievement and limb function

Based on our experience we recommend Ilizarov fixator for all kinds of femoral fractures whether fresh or non unions.Further studies are suggested to be done on this topic.

REFERENCES

1. Yin P, Zhang L, Li T, Zhang L, Wang G, Li J et al. Infected nonunion of tibia and femur treated by bone transport. J Orthop Surg Research 2015; 49 (10):2-9.
2. Harshwal RK, Sankhala SS, Jalan D. Management of nonunion of lower extremity long bones using mono-lateral external fixator–Report of 37 cases. Injury. 2014;45(3):560–7.
3. Yin P, Zhang Q, Mao Z, Li T, Zhang L, Tang P. The treatment of infected tibial nonunion by bone transport using the Ilizarov external fixator and a systematic review of infected tibial nonunion treated by Ilizarov methods. Acta Orthop Belg. 2014;80(3):426–35.
4. Feng ZH, Yuan Z, Jun LZ, Tao Z, Fa ZY, Long MX. Ilizarov method with bone segment extension for treating large defects of the tibia caused by infected nonunion. Saudi Med J. 2013;34(3):316–8.
5. Liu T, Yu X, Zhang X, Li Z, Zeng W. One-stage management of posttraumatic tibial infected nonunion using bone transport after debridement. Turk J Med Sci. 2012;42(6):1111–20.
6. Arora S, Batra S, Gupta V, Goyal A. Distraction osteogenesis using a monolateral external fixator for infected non-union of the femur with bone loss. J Orthop Surg (Hong Kong). 2012;20(2):185–90.
7. Blum AL, BongioVanni JC, Morgan SJ, Flierl MA, dos Reis FB. Complications associated with distraction osteogenesis for infected nonunion of the femoral shaft in the presence of a bone defect: a retrospective series. J Bone Joint Surg. 2010;92(4):565–70.
8. Barquet A, Silva R, Massaferro J, Dubra A. The AO tubular external fixator in the treatment of open fractures and infected non-unions of the shaft of the femur. Injury 1988; 19:415–20.
9. Chaddha M, Gulati D, Singh AP, Singh AP, Maini L. Management of massive posttraumatic bone defects in the lower limb with the Ilizarov technique. Acta Orthop Belg. 2010;76(6):811–20.
10. Barbarossa V, Matkovic BR, Vucic N, Bielen M, Gluhinic M. Treatment of osteomyelitis and infected non-union of the femur by a modified Ilizarov technique: follow-up study. Croat Med J 2001:42; 634–41.
11. Selhi HS, Mahindra P, Yamin M, Jain D, De Long WG, Singh J. Outcome in patients with an infected nonunion of the long bones treated with a reinforced antibiotic bone cement rod. J Orthop Trauma. 2012;26(3):184–8.
12. Megas P, Saridis A, Kouzelis A, Kallivokas A, Mylonas S, Tyllianakis M. The treatment of infected nonunion of the tibia following intramedullary nailing by the Ilizarov method. Injury. 2010;41(3):294–9.
13. Aronson J, Johnson E, Harp JH. Local bone transportation for treatment of intercalary defects by the Ilizarov technique. Biomechanical and clinical considerations. Clin Orthop Relat Res 1989; 243:71–9.
14. Sala F, Thabet AM, Castelli F, Miller AN, Capitani D, Lovisetti G, et al. Bone transport for postinfectious segmental tibial bone defects with a combined Ilizarov/Taylor Spatial Frame technique. J Orthop Trauma. 2011;25(3):162–8.
15. Cierny G III, Zorn KE. Segmental tibial defects Comparing conventional and Ilizarov methodologies. ClinOrthop Relat Res 1994;301: 118-123.
16. Song HR, Chon SH, Koo KH et al. tibial bone defects treated by internal bone transport using the Ilizarov Method. Int Orthop 1998 ; 22 : 293-297.
17. Saleh M, Rees A. Bifocal surgery for deformity and bone loss after lower-limb fractures. Comparison of bone-transport and compression-distraction methods. J Bone Joint Surg 1995 ; 77-B : 429-434.
18. Magadum MP, BasajaravYadav CMB, Phaneesha MS, Ramesh LJ. Acute compression and

lengthening by theIlizarov technique for infected non-union of the tibia with large bone defects. J Orthop Surg 2006 ; 14 : 273-279.
19. Maini L, Chadha M, Vishwanath J, Kapoor S, Mehtani A, Dhaon BK. The Ilizarov method in infected nonunion of fractures. Injury. 2000;31(7):509–17.
20. Paley D. Problems, obstacles, and complications of limb lengthening by the Ilizarov technique. Clin Orthop RelatRes 1990;250: 81-104.
21. Cattaneo R, Catagni M, Johnson EE. Th e treatment of infected nonunions and segmental defects of the tibia by the methods of Ilizarov. Clin Orthop Relat Res 1992; 280: 143-52.
22. Barbarossa V, Matković BR, Vucić N, Bielen M, Gluhinić M.Treatment of osteomyelitis and infected non-union of thefemur by a modifi ed Ilizarov technique: follow-up study. CroatMed J 2001; 42: 634-41.
23. Dendrinos GK, Kontos S, Lyritsis E. Use of the Ilizarovtechnique for treatment of nonunion of the tibia associatedwith infection. J Bone Joint Surg Am 1995; 77: 835-846.
24. Paley D, Rumley OT Jr, Kovelman H. The Ilizarov technique: a method to regenerate bone and soft tissue. In:Habal M, editor. Advances in plastic and reconstructive surgery. Chicago (IL): Year Book Medical Publishers;1990. p. 1-41.
25. Urazgil'deev ZI, Roskidailo AS. Treatment of ununited fractures and pseudarthrosis of long bones of the lowerlimbs complicated by osteomyelitis [in Russian]. Khirurgiia (Mosk) 1999 ;(9):48-54.