Internal fixator „Mitkovic” in the treatment of fractures of femoral shaft – a possible solution for fractures in heavier children and adolescents

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INTRODUCTION

Background: Management of femoral shaft fractures in older and heavier children and adolescents is still challenging and controversial and includes several modalities of fixation. Aim of this study was to analyze single center experience in application of self-dynamisable internal fixator Mitkovic (SIF) for the treatment of fractures of femoral shaft in children and adolescents. Methods: Retrospective analysis of data of pediatric and adolescent patients treated for diaphyseal fracture in single center has been conducted. Results: Eleven patients, with 12 femoral shaft fractures were treated in ten-year-period with internal fixator “Mitkovic”. Time to fracture healing ranged from 4-12 weeks (average 8.9 weeks). All fractures healed without complications. No rotational or angular mal-alignment was noticed. No external cast immobilization was applied in any patient. Conclusion: Self-dynamisable internal fixator Mitkovic may be considered as viable option for treatment of femoral fractures in older/heavier children and adolescents particularly with unstable fracture patterns.

Key words: femur fractures, children, adolescents,

Diaphyseal femur fractures in children and adolescents are not the most common, but certainly are the most severe fractures of the extremities in that age group1. Elastic stable intramedullary nailing (ESIN) become golden standard of treatment of femoral fractures in pediatric population2,3. But in older and heavier children, weighing more than 50 kg and occasionally obese ESIN may not provide sufficient stability resulting in increased rate of complications such as loss of reduction, delayed or nonunion, refractures and limb length inequality. As standard rigid intramedullary interlocking nails cannot be applied in skeletally immature patients several alternatives to ESIN has been proposed for treatment of adoles-

cent femoral shaft fractures. End caps and addition of third nail4 has been used to increase stability of fixation of adolescent femur fractures. Another method to treat adolescent femoral shaft fractures is plate osteosynthesis either as open plating or submuscular bridging plating (SMB)5,6. Finally, rigid intramedullary nail with lateral (trochanteric) entry point (ALFN), specially designed for skeletally immature patients has been reported as good alternative to ESIN in heavier adolescents7. Mitkovic designed original implant, named internal fixator for diaphyseal femoral fractures and reported results of its application in adults8,9. Aim of this study was to analyze single center experience in application of internal fixator Mitkovic for the treatment of fractures of femoral shaft in children and adolescents.

PATIENTS AND METHODS

We conducted retrospective analysis of hospital records, intraoperative charts, initial and follow-up clinical and X-rays findings of patients operated on for femoral shaft fractures in single tertiary pediatric surgery teaching hospital. Patients whose fractures were surgically stabilized with internal fixator Mitkovic are included in the study. All patients treated from January 2003 and December 2013 was included. Patients with pathological femoral shaft fractures were excluded. Follow-up period was minimally 12 months. Implant was manufactured by „TRAFFIX“ D.O.O. Niš, Serbia. Original implant with 10 mm diameter bar has been used in older, heavier children and adolescents and smaller 8 mm diameter bar for younger patients. We follow the operative technic in details as described by author8,9. In all cases fractures were fixed with two 4.5mm bolts in each fragment with addition of one 3.5mm anti-rotational screw in one and another 3.5mm locking screw in opposite fragment. No external cast immobilization was applied in any patient. Patients were routinely followed up clinically and X-ray immediately post operation, and then after discharge
from hospital on 4, 6, 8 and 12 week post-surgery and then every 3 months in the first year. Implants were removed after 12-18 months postoperatively.

RESULTS

Eleven patients, with 12 femoral shaft fractures (one patient have had bilateral fracture) age 7-17 years (mean 12.7) were treated. There were 8 boys and 3 girls. The most common cause of injury was pedestrian vs. motor vehicle accident in 5 cases followed by bicycle vs. motor vehicle in 2, passenger in car crash in 2, fall from motorcycle in 1 and fall from the height in 1 patient. Four patients had multiple injuries while the rest 7 had isolated fractures of the femur. Three patients were operated on within first 24h and the remaining patients were operated within 72h post injury. All procedures were conducted under general anesthesia on fracture table. After reduction of fragments internal fixator was applied according to author's technique. In younger patients, where skin bridge between two incisions for placement of fixator was too short (less than 2-3 cm) we preferred to make full length incision for better cosmesis. Wound drainage has not been routinely applied. All operative wounds healed uneventfully without complications and stitches have been removed on tenth postoperative day. As no cast immobilization was applied patients were encouraged to freely move their operated extremity in bed. Verticalization with support of crutches and supervision of physical therapist started as soon as patient's condition allows it preferably day after surgery. Weight bearing was allowed as tolerated, except in patient with bilateral femoral fracture, in whom weight bearing and walk on crutches had been allowed in fourth postoperative week. Fracture was considered healed once bridging callous has been clearly visible on three cortices on X-ray. Time to fracture healing ranged from 4-12 weeks (average 8.9 weeks). All fractures healed without complications. No rotational or angular mal-alignment was noticed. Two comminuted fractures have healed with abbreviation of 0.5 cm originally accepted at reduction. No complications related to implant or hardware failure were recorded. We encouraged mobilization of patients as early as possible. Two patients could not be mobilized early because of concomitant injuries. Three patients have been mobilized on day 3 to 5 post surgery due to fear, pain or lack of cooperation. As partial weight bearing was difficult to control in this age group weight bearing as tolerated by individual patient has been allowed. Once fracture was considered healed, as demonstrated by 3 bridging cortex in 2 standard X-ray views gait support has been discontinued. Patients were advised restriction in sport activities 3-6 months postoperatively. Implant removal was planned about one year postoperatively but actually has been removed between 12 and 18 months. Because of implant design no bone overgrowth was observed even after 18 months, but some patients have developed reactive bursa around bolts. Upon to implant removal patients were advised restriction in sport activities for 3-4 weeks. No refractures occurred in follow-up period. We tried to keep all patients on regular clinical follow up visits once a year for at least five years and 8 out of 11 patients obey that protocol. No significant limb length discrepancies were observed by patients, their parents or their treating physicians and no ortoradiographs were taken to measure limb equality.

DISCUSSION

The management of children's fractures has evolved as a result of better health education, changes in lifestyle, improved implant technology and the changing expectations of society. While recommendations for the treatment of femoral fractures in children and adults are quite clear and straightforward in children heavier than 50 kg and in skeletally immature adolescents, treatment strategy and choice of optimal implant is still controversial. Main reason for concern is insufficient stability of titanium nails used for ESIN in heavier patients and in complex, length-unstable fractures even in younger patients. Slongo et al. reported that use of end caps may increase stability of ESIN in heavier children but Kaiser et al. in biomechanical in vitro study failed to demonstrate that improvement. Modification of ESIN by addition of third nail (preferably inserted laterally) significantly improve stability both in biomechanical and clinical studies. Rigid intramedullary nailing with trochanteric entry point was reported to decrease recovery time after femoral fracture in heavier children and adolescents but incidence of major and minor complications was not significantly decreased compared to ESIN. Main concern in rigid intramedullary nailing in adolescents is smaller diameter of medullary canal than in adults. Recently, submuscular plating has been found to be a successful alternative option for management of length-unstable femoral fractures and in older and/or heavier children who have a femoral canal that is too small to accommodate a rigid intramedullary nail. Porter et al in two simulated pediatric fracture model found that locked plating provides a biomechanically more stable construct than elastic intramedullary nailing. Abdelgawad et al in the largest published report of SMB in pediatric patients found that SMB for complex femur fractures reliably provides better alignment and leg length than all other forms of treatment. They recommend SMB as preferred method of treatment of complex, length-unstable femur fractures. Submuscular bridging plating is preferred over open plat-}

ing because of its soft tissue sparing and decreased risk of complications, although Abbott et al, in their study that compared SMB end open plating of femoral fractures did not found significant difference. Mitkovic developed original internal fixation (SIF) device for femoral fractures and reported results of its application in adult patients. Application of this implant utilizes similar minimally invasive, soft tissue sparing approach. To the best of our knowledge this is the first published report of the use of SIF in pediatric patients. The main limitation of our study is relatively small number of patients. Anyway, uniformly good results in all 11 patients with 12 femur fractures, which healed uneventfully without complications make us believe that SIM is reliable procedure in children and adolescents. Especially in older and
heavier children and adolescents and in length-unstable fracture patterns use of SIM have advantages over ESIN because it provides better fracture stability. SIM may have advantage over rigid intramedullary nailing particularly in adolescents with still narrow medullary canal which precludes insertion of rigid intramedullary nail. In our series we did not observed effect of selfdynamisation described by Mitkovic et al16. Possible explanation could be small number of patients as well as faster healing of fractures in children. In adult patients selfdynamisation have occurred after 6-8 weeks post operation, time when most of pediatric femur fractures already have healed. In recent study that compared results of external fixation, ESIN, rigid intramedullary fixation and SMB for treatment of femur fractures in adolescents Ramseier et al reported that external fixation was associated with the highest rate of complications. Although the other three methods yielded comparable outcomes, they could not recommend one method of fixation for all adolescents with a femoral fracture16. The choice of fixation will still be influenced by surgeon, patient and fracture characteristics. Thus SIF may be considered for treatment of femoral fractures in older/heavier children and adolescents particularly with unstable fracture patterns.

SUMMARY

UNUTRAŠNJI FKISATOR „MITKOVIĆ“ U LEČENJU DIJAFIZNIH PRELOMA FEMURA – MOGUĆE REŠENJE ZA PRELOME U DECE VEĆE TELESNE MASE I ADOLESCENATA


Ključne reči: prelom femura, deca, adolescenti, unutrašnji fiksator

REFERENCES


