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Midterm results of a single stage medial epiphysioloysis with high tibial osteotomy in treatment of severe infantile tibia vara

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Abstract
Objectives: Assessment of treatment of severe infantile tibia vara by high tibial osteotomy and epiphysiolysis of the proximal medial tibia.
Patient and methods: Between January 2009 and May 2014, 14 cases of severe tibiae vara were treated by medial epiphysiolysis and high tibial vulgus osteotomy. Mean age at operation was 7 years (range 5-8 years). Preoperative radiological assessment was done by long x-ray film anteroposterior and lateral. Post-operative clinical and radiological follow up for four years. Postoperatively, the patient is monitored for resumption and continuation of growth. The procedure was successful in restoring growth and correction of angular deformity.
Result: All cases had good results with no recurrence and no post-operative complications with mean full up of four years.
Conclusions: Medical epiphysiolysis combined with high valgus osteotomy is a good alternative for recurrent osteotomies in cases of severe tibia vara as it restores proximal tibial growth.

Keywords: Tibia vara, epiphysiolysis, vulgus osteotomy

Introduction
Valgus osteotomy for advanced infantile tibia vara often followed by recurrence of deformity. Significant growth disturbance of proximal medial tibia physis not corrected by simple mechanical uploading of the medial compartment of the knee by valgus osteotomy. Growth disturbance leads to recurrence of deformity in tibia with Langenskiöld stage III and more even though a discrete bony bridge not evident. Repeated osteotomies are not good solution as it is associated with increased risk of vascular complication and infection and limb shortening. Lateral epiphysiodesis will prevent recurrence of deformity by arrest of growth, but there will be a need for lengthening procedures [2].
Langenskiöld [3] described the use of partial physeal arrest resection for partial closure of the growth plate in thirty five patients. Management of infantile tibia vara begins with identification of the site and size of the physis arrest using imaging and calculation of the expected growth remaining in the affected physis. Medial epiphysiolysis combined with high tibial vulgus osteotomy using interpositional fat or methyl methacrylate is good solution. Andrade and Johnston [2] examined the efficacy of physeal arrest resection for patients with earlier stage disease (Langenskiöld stage IV and V) before development of bony arrest. They reported successful restoration of growth with no recurrence of varus deformity in more than eighty percent of patients younger than age seven years.

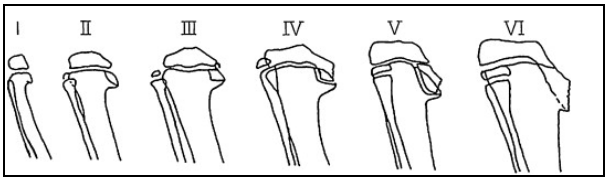


Fig 1: Langenskiöld's radiological classification [4].

The aim of the work

The aim of this study was to evaluate the results of medial epiphysiolysis combined with high tibial vulgus osteotomy in treatment of sever tibia vara and restoring growth of proximal tibial physis and prevent recurrence of varus deformity in patients with severe infantile tibia vara.

Methods

Between January 2009 and May 2014, 14 cases of severe tibia vara in 12 patients underwent medial epiphysiolysis of proximal tibial physis combined with high tibial valgus osteotomy for correction of severe tibia vara deformity. All cases had severe tibia vara deformity with langenskiöld type III or more. The mean age at the operation was 7 (range5-8) years. The mean follow up period was 4 years. Preoperative standing long leg radiographs were done to detect the angle between the mechanical axis of the tibia and the mechanical axis of the lower limb and to detect the stage of tibia vara according to langenskiöld classification. Postoperative long leg radiographs were taken at every follow up visit and at the end of follow up to detect the recurrence of deformity and assess growth of the affected tibia and correction of the deformity.

Table 1: Patient Data

N	Age at surgery (y)	Langenskiöld	Mechanical axis			Postop growth (ec)		Result
			Pre	Post	Final	Affected	Unaffected	
1	6.3	VI	30	-5	3	7	7.5	G
2	7.1	V	12	-3	2	6.5	6.2	G
3	5.4	V	20	-6	4	10	11	G
4	6.5	IV	15	-4	4	7	8	G
5	7	V	19	-8	-6	7.5	7.7	G
6R	7.5	IV	20	5	5	10	9.2	G
6L	6.8	III	12	6	-5	7	6	G
7	6.7	IV	22	-6	-4	6	7	G
8	7.2	IV	14	-5	2	6	5.8	G
9	6.5	V	18	-7	-4	8.3	8.2	G
10R	6.1	V	16	6	7	10	9.5	G
10L	7.2	V	20	4	-3	7	8	G
11	7.5	III	18	5	4	9	9	G
12	8	IV	20	-3	-3	6	7	G

The study includes twelve patients including two bilateral cases. Eight cases were female and four were male. The average age at medial epiphysiolysis was 7 (range 5.2- 8) years. There were 2 cases langenskiöld grade III, 5 cases langenskiöld type IV, 6 cases V and 1cases type VI. None of our cases had previous operation for correction of the deformity.

The mean preoperative mechanical axis of the affected limbs was 21.2 degree angle varus (12 -30 degree angle) and the mean preoperative length of the affected and contralateral tibia was 27.5 cm and 28.3 cm, respectively.

Surgical technique

Under general anesthesia, tourniquet, and fluoroscopic control, the patient was placed in supine position. After draping, the skin incision started just proximal to the joint line and in the middle of the medial surface of the tibia, and extended distally five cm distal to the tibial tubercle to facilitate doing the osteotomy through the same incision.

With careful dissection, the insertion of pes anserinus was sharply elevated from anterior to posterior. Under fluoroscopic control, assisted by probing with a needle, the bridge was located and exposed. The inferiorly directed epiphysio-metaphyseal beak was removed using curved osteotome, which was placed between the beak and tibial metaphysis and directed proximally posteriorly and anteriorly to remove all the beak, then with curette all the non-bony tissues in the area were removed. The obvious bulk of the bony bridge is removed until translucent cartilage were encountered. The epiphysis was elevated by periosteal elevator. The defect created by elevation of the epiphysis and excision of the beak is filled with bone cement incorporated with the epiphysis with two Kirschner wires from medial to lateral to prevent down displacement of the medially unsupported portion of the epiphysis. A separate skin incision was done for the fibular osteotomy over the proximal fibula.

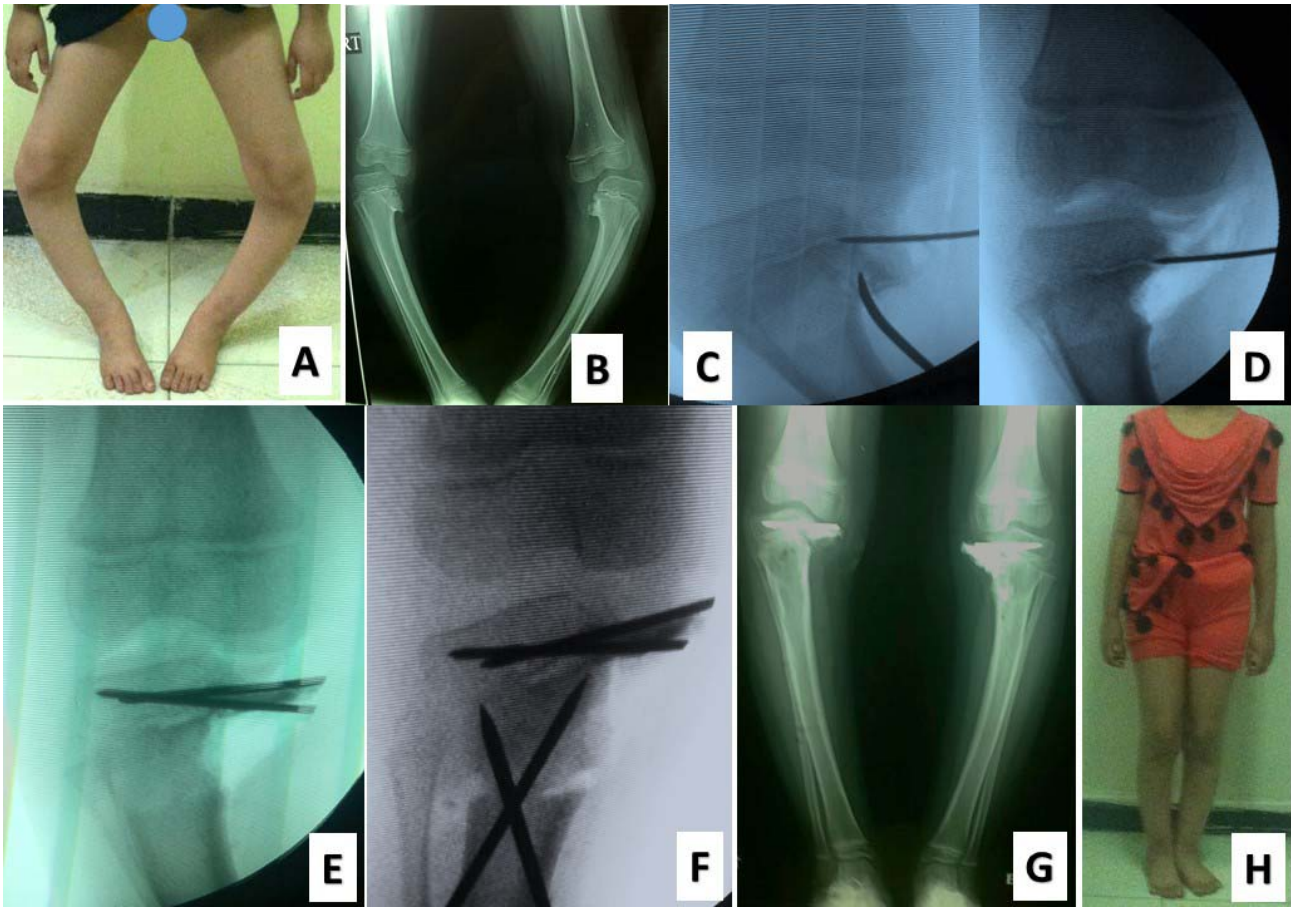
After hardening of the bone cement, the tibial mestaphysio-diaphyseal junction was exposed sub periostealy in the distal part of the incision. The osteotomy was made distal to the tibial tuberosity. After full correction, the osteotory was fixed by two crossing K wires.

Post operatively long leg cast was done in corrected position with the knee slightly flexed. Non weight bearing was advised until the osteotomy site united adequately. Then rehabilitation was done to regain full range of motion of the knee. The crossing wires of the osteotomy were removed at the outpatient clinic after healing of the osteotomy.

Results

The results of the procedure was evaluated according to growth of proximal physis after operation, recurrence of deformity and further surgeries required A good result was defined as greater than fifty percent of growth compared with the unaffected slide and less than ten degree of varus at final follow up, and requires no other surgery other than epiphysiodisis. A fair result was considered when observable growth of affected tibia with recurrence of varus more than ten degree of varus that needs hemiepiphysiodesis and /or osteotomy. A failure is defined as ineffective growth of medial physis, with recurrence of varus requiring multiple procedures to correct both the deformity and leg length inequality. All cases had a good outcome with no recurrence. At the last follow up only 4 cases had limb length inequality about 1 cm which was adjusted by shoe elevation. There were no cases of delayed union, nonunion nerve injury or compartment syndrome. There was only one case which was complicated by wound dehiscence.

The mean postoperative mechanical axis of the affected limbs was -2.6 (range-8 to 6) degree angle and at the final follow up was 4 (range -6 to 7). The mean preoperative length of the affected and contralateral tibiae was 27.5 cm and 28.3 cm, respectively. The postop growth of the affected and unaffected tibiae was 7.87 (5-11) cm and 7.99 (5.5-11.5) cm, respectively (table 1).



Case presentation:
Case No. 3: A) Pt. photo preoperative with bilateral sever infantile tibia vara;
B) Long plain x-ray film showing the deformity and the epiphyseal-metaphyseal beak;
C) Intraoperative x-ray showing detection of the physis and removal of the beak;
D) Intraoperative x-ray after removal of the beak;
E) Fixation of the epiphysis with 2 k wires incorporated with bone cement;
F) After proximal valgus osteotomy and 2 k wires fixation;
G) Final x-ray after healing of the osteotomy and removal of the k wires;
H) Photo of the patient after the end of follow up with correction of the deformity.

Discussion

According to Andrade Nicholas *et al* (2006), the success of the epiphysiolysis did not depend on the stage of langenskiöld or preoperative mechanical axis, age of the patients play a mean role. The younger the age of the patients at the operative time, the better the results. The older the age of the patient at operative time is associated with fair or poor results. They also found that if there were previous operations for correction of the deformity, the incidence of failure would be more associated. Nicolas was the first one who correct the varus deformity by medial eiphysolysis (1983), there were only three cases with his study [2, 5].

In our study, there were 2 cases langenskiöld grade III, 5 cases langenskiöld type IV, 6 cases V and 1cases type VI. If the mechanical axis was well corrected during the procedure of epiphysiolysis, there was a high incidence of good results.

According to the study that was done by Nicholas *et al* (2006), patients younger than seven years, with a Langenskiöld stage IV or greater, had more than eighty percent chance of good restoration of proximal tibial growth and no need for subsequent lengthening procedures. If the mechanical axis corrected at the same time of epiphysiolysis in this young age group, the incidence of successful correction may have been higher. The only 2 failures in the patients younger than 7 years were partially due to varus under correction at the time of surgery. For patients older than 7 years, the results of epiphysiolysis are less predictable, and thus other treatment options may be required [2].

Technically epiphysiolysis may be difficult to control intra operatively, and this gives a less satisfactory results because of varus recurrence. Intraoperative determination of the adequacy of resection and epiphysiolysis should be confirmed by fluoroscopic imaging, to ensure the resection has extended lateral enough [1].

Multiple repeated osteotomies as a treatment options for advanced stage of infantile tibia vara are controversial and often requires staged or multiple procedures. Multiple osteotomies produces significant gait disturbance or pain and the patient is subjected to repeated neurovasular risk from the osteotomies union and infection. Furthermore, repeated osteotomies, osteotomies may not correct completely the limb length disturbance related to the physeal arrest of the proximal medial tibial physis which is responsible for recurrence of deformity**.** The proximal tibial epiphysiodesis with lateral physeal arrest is an option to prevent recurrent deformity, but requires a limb lengthening procedure because of the significant shortening expected by a complete proximal tibia epiphysiodesis in the younger age group children [6, 7].

Lengthening procedures can be done as a single stage procedure to correct both deformity and shortening but requires a prolonged treatment period, with possible complications from external fixation. For patients older than 7 years, the success of the procedure of medial epiphysiolysis with mechanical correction of tibia vara is less predictable and such patients may be better treated by other alternatives [8, 9].
Advanced stages of infantile tibia vare always needs multiple operation for correction of deformity as multiple osteotomies with or without tibial lengthing. Therefore by regarding the stage III or greater with severely damaged physis, removal of the damaged portion of the physis with placement of an interposition material to prevent retethering of the resected area combined with correction of the mechanical axis is a reasonable solution to obtain lasting correction [9, 10].

Conclusion

Medial epiphysiolysis with mechanical correction of tibia vara by high tibial valgus osteotomy as a single stage procedure in the child with Langenskiöld grade III or greater lesion is a good treatment option, with the ideal patient appearing to be younger than 7 years.

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