ПАТОЛОГИЧЕСКИЕ ПЕРЕЛОМЫ ПОСЛЕ УДЛИНЕНИЯ КОСТИ

PATHOLOGICAL FRACTURES FOLLOWING BONE LENGTHENING

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С декабря 1985 года в нашем отделении было проведено 197 удлинений конечностей.
Бедро: 87 случаев - среднее удлинение составило 8,5 см (в пределах от 4 до 15 см).
Большеберцовая кость: 92 случая - среднее удлинение составило 7,3 см (в пределах от 3 до 15 см).
Плечевая кость: 18 случаев - среднее удлинение составило 9 см (в пределах от 8 до 10 см).
После операции наблюдали 14 переломов, т.е. 7% случаев.
Показаниями к удлинению являлись следующие:
нижняя конечность: врожденные (17 гемимелий малоберцовой кости, 5 фокомелий и врожденной соха vara, 26 случаев низкорослости, включая 12 ахондроплазий), постинфекционные (10) или посттравматические эпифизеодез и неправильное сращение (14);
верхняя конечность: 18 плечевых костей, врожденные, варусная деформация плеча (2), ахондроплазия (12), постинфекционные (3) и костная киста (1).
Повреждение бедра отмечалось в 9/87 случаях (10%); повреждение большеберцовой кости - в 3/92 (3,2%) случаях; плеча - в 2/18 (11%). Переломы имели место, главным образом, при больших удлинениях (более 7 см). Они происходили в ранние сроки (в течение 3 месяцев) после снятия аппарата: 35% или позднее (в сроки от 3 до 6 месяцев): 56%. Один перелом произошел в очень поздний срок - через 15 месяцев: 5%. Они происходили в равной степени при врожденной и других этиологиях. Однако, в меньшей степени они отмечались при ахондроплазии (2 случая).
Анатомически было выявлено 3 категории:
1) Поперечный перелом с угловой деформацией, но без смещения отломков по длине (8 случаев, включая 7 в области бедра) отмечался в ранние сроки (в течение 3 месяцев после операции). При таком нестабильном типе перелома показана ESIN (методика Nancy).
2) Пластическое сгибание: 2 случая со сгибанием небольшой степени, которое стабилизовали гипсовой повязкой, а в 3-х случаях со сгибанием значительной степени потребовалось наложение нового аппарата наружной фиксации.
3) Смещение отломков по длине (2 случая): такие переломы неподдаются вправлению (ретракция мягких тканей), поэтому надо накладывать новый аппарат наружной фиксации.
После обзора литературы и выявления причины переломов, возникающих после удлинения, на основании нашего опыта мы пришли к выводу, что для предупреждения смещения и захождения отломков при переломах с угловыми деформациями показано применение ESIN.
Ключевые слова: патологические переломы, удлинение кости, дети.

197 limb lengthenings were performed in our Department since 1985.
Femur: 87 cases - average gain 8,5 cm (ranging from 4 to 15 cm)
Tibia: 92 cases - average gain 7,3 cm (ranging from 3 to 15 cm)
Humerus: 18 cases - average gain 9 cm (ranging from 8 to 10 cm) 14 fractures were observed after surgery, i.e. 7 % of cases. Indications for lengthening were : lower Umb : congenital (17 fibular hemimelias, 5 phocomelias and congenital coxa-vara, 26 short statures among then 12 achondroplasias), post-infectious (10) or post-trauma epiphysiodesis and malunion (14).
upper limb: 18 humerus : congenital : humerus varus (2), achondroplasia (12), post-infectious (3) and bone cyst (1).
The femur was involved in 9/87 cases (10 %) ; tibia in 3/92 (3,2 %) and humerus in 2/18 (11%). Fractures occurred preferentially for large gains (over 7 cm). They were observed early (within 3 months) after apparatus removal : 35 %, or later (between 3 to 6 months) : 56 % . One very late fracture occured at 15 months : 5 %. They occured at equivalent rates in congenital and other etiologies. However, they occur less in achondroplasia (2 cases).
Anatomically 3 categories were individualized:
1°) Transverse fracture with angulation but without overlapping (8 cases, among then 7 femoral) observed early (3 post-op. months). This fracture type is instable and justifies an ESIN (Technique from Nancy).
2°) Plastic inflexion: 2 cases of moderate inflexion, stabilized with a cast and 3 cases of large inflexion, needing a new external fixator.
3°) Overlapping (2 cases) : these fractures are irreducible (soft tissues retraction) and must be treated with setting of a new external fixator.
After a review of the literature, and the etiology fractures occurring after lengthening, we conclude, based on our experience, that an angulated fracture needs an ESIN to prevent displacement and overlapping.
Key words: pathological fractures, bone lengthening, children.

INTRODUCTION

Fractures of the newly formed bone is a feared complication after skeletal lengthening not only because of the prolongation of infirmity and the disturbance to the therapeutic regime, but also and above all, because of the risk of secondary displacement with overriding with can lead to a considerable loss of length. Once displaced, these fractures of the regenerate bone are irreducible by closed reduction techniques because of the tension in the soft tissues resulting from the distraction. In a certain number of cases we are confronted which minimally displaced fractures diagnosed early and the therapeutic goal is then to avoid the development of overriding.

MATERIAL AND METHODS

Our series comprised a total of 197 segmental lengthening procedures in 76 children from 7 to 17 years of age. All were performed using the ILIZAROV device.

197 lengthening procedures. 76 Patients

FEMUR	87 cases	Average lengthening:	8,5 cm. (range 4 to 15 cm.)
TIBIA	92 cases	Average lengthening	7,3 cm. (range 3 to 15 cm.)
HUMERUS	18 cases	Average lengthening	9 cm. (range 8 to 10 cm.)

Indications for bone lengthening were:

LOWER EXTREMITY

(179 procedures - 72 patients)

Congenital causes

- Fibular hemimelia: 17 patients
- Hypoplastic femur: 5 patients
- Achondroplasia: 12 patients
- Congenital short stature < 145 cm: 14 patients.

Congenital causes

- Post-traumatic leg length discrepancy (epiphysiodesis, malunion etc) : 14 patients
- Post-infectious discrepancy : 10 cases

UPPER EXTREMITY

18 procedures -12 patients

Congenital causes

- Humerus varus: 2 procedures
- Achondroplasia: 12 procedures

Congenital causes

- Post-infectious (neonatal) : 3 procedures
- Bone cyst: 1 procedure

Among these 197 lengthening procedures we observed 14 fractures (7%):

Femur:9 fractures (87 procedures) (10%)

Tibia:3 fractures (92 procedures) (3,2 %)

Humerus: 2 fractures (18 procedures) (11%)

With special attention to chronological occurrence of the fractures we noted:

Concerning the femur: 3 fractures that occurred immediately after removal of the Ilizarov device (early fractures) and 6 fractures that occurred 3 to 6 months after the fixator removal, (late fractures).

Concerning the tibia: there were 3 late fractures between 3 to 6 months and I very late fracture that occurred after 15 months during a rather violent rehabilitation session.

Concerning the humerus: 2 cases of moderate bowing immediately after removal of the Ilizarov device without any significant clinical consequence.

COMMENTS

I - ANATOMICAL CLASSIFICATION

Fractures secondary to bone lengthening can be classified in three different and specific categories:

1°) Transversal fissure-fracture with slight angularion but without any overriding.

2°) Plastic bowing of the lengthened bone; two types of bowing should be distinguished:

a) moderate bowing that is stable without consequence on function.
b) severe bowing, progressing, with extreme bone deformation.

3°) Complete fracture always with pronounced overriding at the fracture site.

1°) TRANSVERSAL FISSURE-FRACTURE

We observed this type of partial fracture 8 times and essentially in femur (7 cases) and only once in tibia. This type of fissure-fracture is unstable and in spite of conservative treatment by cast immobilisation, there is high risk for secondary displacement with irreducible overriding.

Therefore we treat these fractures by elastic stable intramedullary Nailing (E.S.I.N.) with good results.

2°) PLASTIC BOWING

We noted 2 cases of moderate diaphyseal bowing in humerus after major lengthening procedures. We think moderate bowing can be stabilized by simple splinting or cast immobilization. Indeed there is no tendency to secondary displacement and prognosis is good. On the contrary, severe bowing,

which is often seen in cases of congenital malformations is much more serious. Pronounced bowing can only be stabilized an redressed with reapplication of the Ilizarov fixator (3 cases : 2 fibular hemimelia, 1 hypoplastic femur).

3°) OVERRIDING FRACTURES

Overriding fractures after bone lengthening are completely irreducible because of soft tissue tension. Therefore, reapplication of the external fixation is the only solution to restore length (2 cases of femur lengthening in obese achondroplatic patients).

II - REVIEW OF LITERATURE

Review of literature in search of statistic data about fracture complications after bone lengthening is rather disappointing. The major complication is mentioned only briefly by the majority of the authors. TJERNSTROM & al. (3) reported 4 fractures in 53 lengthening procedures, that are approximately 9 %, which is slightly superior to our study (14 fractures/197 procedures). ATAR & al. (1) experienced 3 fractures in 36 procedures (8,3 %). Average lengthening was 10 cm in femur, 7,5 cm in tibia and II cm in humerus. This percentage is similar to the report of Tjemstrom. For comparison, CHANDLER (2) had also a 10 % fracture rate after Wagner's procedure with in addition, 20 % of infection and 20 % of non-union.

III - ETIOLOGY

Even in case of a bone lengthening of only a few centimeters in a normal femur, secondary fracture may occur. Independently from surgical technique, there obviously are some risk factors for secondary fracture after bone lengthening. These are:

1°) bone lengthening superior to 10 cm;

2°) anticipated removal of the external fixator because of intolerance, pin track infection, delay...

3°) structural malformation of the specific bone.

In our series, two cases of severe bowing occurred in patients with fibular hemimelia after lengthening of tibia superior to 10 cm.

On the contrary, in achondroplasia with average lengthening of about 12 to 15 cm, we observed only 2 fractures. Indeed we noted that in achondroplasia the bone regenerate is voluminous and has early solidity.

CONCLUSION

Early and late fractures after bone lengthening have a 10 % incidence in femur and humerus and a 3% incidence in tibia. Treatment depends on the anatomical type of the fracture. Partial fracture without overriding can be successfully stabilized by Elastic Stable Intramedullary Nailing, thus avoiding secondary displacement with the necessity of reapplication of the Ilizarov fixator. Nailing through the bone regenerate is not always easy but is mostly possible because the bended nail can be directed by turning the handle under fluoroscopy. We have a great experience in Elastic Stable Intramedullary Nailing as a routine treatment in limb fractures in children. We were very satisfied when we used this technique in fractures secondary to bone lengthening, without any failure. Therefore we can recommend this special technique.

Fig. 1. Photo showing the tibial curvature of a child with peroneal ectromelia and a 8 cm lengthening, after external fixator removal.

Fig. 2. X-rays of a spontaneous fracture after a 4 cm lengthening, 4 weeks after the removal of the Ilizarov device femoral.

Fig. 3. X-rays of a spontaneous fracture treated with ESIN.

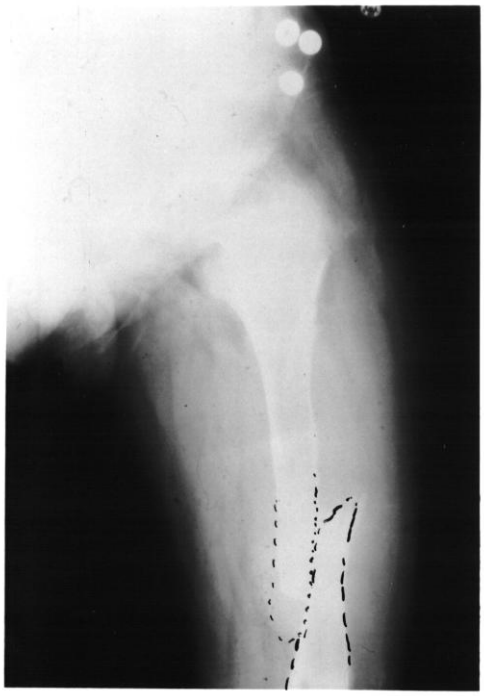

Fig. 4. Irreducible fracture femoral of an achondroplastic patient after a 10 cm lengthening needing the reapplication of an Ilizarov fixator.

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