

S. INOKUCHI - K. OGAWA AND N. USAMI

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IN CHILDREN UNDER THE AGE OF TEN

Estratto da:

FOOT DISEASES

VOL. 1 - N. 1 / 1994



AULO GAGGI EDITORE
BOLOGNA

Fracture of the Talus in Children Under the Age of Ten

S. Inokuchi - K. Ogawa - N. Usami

Department of Orthopaedic Surgery, School of Medicine, Keio University, Tokyo, Japan.

ABSTRACT: The major talus fractures of children under the age of ten were evaluated. The average age at the injury was 6.9 years and the average follow-up term was 8.3 years. The fracture site was the neck of talus in twenty-three feet, the body in two and the head in three. The sagittal fracture was in two feet and the open fractures in three. The characteristics of radiographies in the talus fracture of childhood was the fracture line running on the posterior wall of the sinus tarsi. Dislocation was observed in six feet and ORIF was performed in nine feet. Aseptic necrosis of the talar body occurred in nine feet. Aseptic necrosis occurred more frequently but improved more quickly in children than in adults. The deformity of the talus remained in six feet. The affected foot was smaller than the opposite foot in four cases. Excellent results of Hawkins' criteria were obtained in twenty cases, good in six, fair in one and poor in no case. The clinical results in children were better than in adults. However, in cases in which talus was deformed, ageing and increasing of bearing force by body weight may make results worse in future.

KEY WORDS: Talus, fracture, dislocation, child, aseptic necrosis.

INTRODUCTION

Major talus fractures may not be seen more than a few times throughout one's professional life, especially talus fractures in childhood, which occur very rarely. Fractures of the talus are well known because they are followed by severe complications like aseptic necrosis and degenerative osteoarthritis^{1,2,3} Moreover, fractures of the talus in childhood disturb their feet

growth up and have some other differences from fractures in adults^{4,5,6,7,8,9} Therefore, the most careful clinical judgment and treatment based on wide experiences are required in order to have good results. So, we should know a lot about the characteristics, the complications and the prognosis of fractures of the talus in children. However, it is difficult for an orthopaedic surgeon to acquire enough knowledge and experience about these fractures in the course of his/her clinical life. So, we studied twenty-seven cases of fractures of the talus in children in order to make their peculiarities clear.

PATIENTS AND METHODS

A total of twenty-seven children under the age of ten were treated from 1976 to 1990 for major fractures of the talus in Keio University Hospital and its participant hospitals. They were clinically evaluated and analyzed on the basis of their roentgenographic appearances (Table I). The mean age at the trauma was 6.9 years (from 3 to 9 years). The mean follow-up period was 9.5 years (from 2 to 16 years). The mean age at the evaluation was 16.3 years (from 6 to 24 years). Nineteen cases (70%) were male and eight (30%) were female. The affected side was left in fourteen cases (52%), right in twelve (44%) and bilateral in one (4%). The site of the fracture was the neck of the talus in twenty-three feet (82%), the body in two (7%), the head in three (11%). The sagittal type fracture was seen in two feet (7%). The dislocation was complicated in six feet (21%) and there were three open fractures (11%). Among twenty-three neck fractures, nineteen (83%) were Type I of Hawkins' classification, three (13%) were Type II and one (4%) was Type III. Eight-

Table I

S.No.	I.D	Name	sex	age at injury	age at follow up		follow up term	side	open Fx.	Fx. site	Fx. type	Dislocation			ORIF	aseptic necrosis	complication	cause	result	
												Sub tal.	Talo Cru.	Talo Nav.						
1	139	K.S	M	3.9	11.0	10/12	7.1	L		neck	ceiling						1st Metatarus Fx.	traffic accident	excellent	
2	180	K.H	M	4.1	14.8	14/10	10.7	L		neck	wall							swing	excellent	
3	101	Y.K	F	4.1	14.7	14/09	10.6	L		neck	wall				+			fall	good	
4	184	S.S	M	4.2	7.4	07/06	3.3	R		neck	wall							swing	excellent	
5	187	M.N	F	4.3	8.3	08/04	4.1	L		neck	wall					+		swing	excellent	
6	141	M.T	M	4.7	16.3	16/04	11.5	L		neck	ceiling							Navicula & Fibula Fx.	traffic accident	excellent
7	26	T.O	M	5.2	19.3	19/04	14.1	L		neck	wall					+		traffic accident	good	
8	126	K.A	F	6.3	18.4	18/05	12.1	R		neck	wall					+		swing	excellent	
9	189	O.S	M	6.3	10.5	10/06	4.2	R		neck	wall							Fibula Fx.	swing	excellent
10	128	A.M	M	6.3	17.0	17/01	10.7	R	+	sagital			+	+				Fibula Fx.	traffic accident	good
11	79	R.S	F	6.7	22.5	22/07	15.8	L		head								Calcaneus & Navicula Fx.	fall & direct force	good
12	215	Y.K	M	6.8	16.7	16/09	9.9	L	+	sagital								Calcaneus & Tibia Fx.	traffic accident	good
13	217	M.K	M	6.8	10.0	09/12	3.1	R	+	neck	wall							traffic accident	excellent	
14	41	M.T	M	6.9	24.6	24/08	17.7	L		neck	wall					+		traffic accident	good	
15	39	K.S	F	7.0	20.8	20/09	13.8	R		neck	wall	+			+			swing	good	
16	135	M.S	M	7.0	15.3	15/03	8.3	R		neck	wall							swing	excellent	
17	84	K.I	M	7.2	19.4	19/05	12.2	R		head								traffic accident	excellent	
18	183	S.Y	F	7.3	14.8	14/10	7.5	R		neck	wall					+		traffic accident	excellent	
19	157	K.H	M	7.6	13.5	13/07	6.0	R		neck	wall							Calcaneus Fx.	swing	excellent
20	76	Y.K	M	8.2	20.7	20/09	12.5	R		neck	wall							fall	excellent	
21	173	J.U	M	8.2	15.2	15/03	7.0	L		neck	ceiling					+		swing	excellent	
22	75	Y.N	F	8.9	22.2	22/03	13.3	L		neck	ceiling	+	+		+	+		fall	fair	
23	154	Y.N	M	8.9	17.3	17/04	8.4	L		head				+	+			Cuboid Fx.	traffic accident	excellent
24	74	T.N	M	9.0	21.9	21/11	12.9	R		neck	wall					+	+	direct force	good	
25	175	N.W	M	9.1	16.3	16/04	7.2	L		neck	wall							swing	excellent	
26	140	K.H	M	9.8	18.2	18/03	8.4	R		neck	ceiling							traffic accident	excellent	
								L		neck	wall	+			+	+		Tibia & Fibula Fx.	good	
27	162	A.T	F	9.9	14.3	14/04	4.3	L		neck	wall	+			+			swing	good	

een out of twenty-three neck fractures had characteristic fracture lines on the posterior wall of the sinus talsi (Fig. 1). There were

complicated foot or ankle fractures on the affected side in nine feet. The cause of the fracture was an accident by a swing while

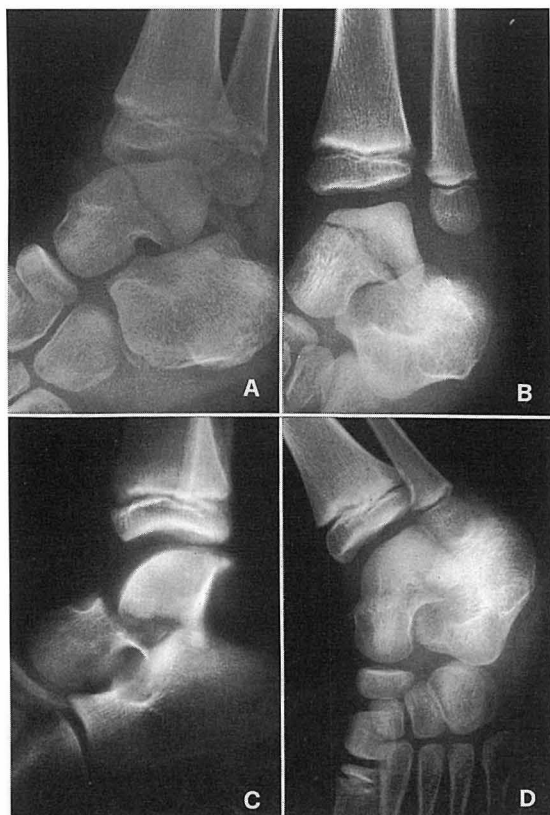


Fig. 1 - Characteristic fracture lines of neck of talus in children run on the posterior wall of sinus talusi. A) is No. 13, B) is No. 19, C) is No. 27 and D) is No. 20.

playing in eleven cases, a traffic accident in eleven, a fall down from a high place in four and direct force in one.

RESULTS

Nineteen feet (68%) without significant displacements of more than 3 mm were treated by plaster Paris under the knee joint for three or four weeks. After removing the plaster, active exercises of ROM of their ankle and subtalar joints started without weight-bearing. Partial bearing was allowed after finding Hawkins' sign on their roentgenogram. Nine feet (32%) with displacements of more than 3 mm or dislocations, were reduced surgically and fixed internally. After the operation, they were fixed externally by plaster under their knee for less than three weeks.

We diagnosed the avascular necrosis of



Fig. 2 - Aseptic necrosis occurs after Hawkins' Type III neck fracture-dislocation in Case No. 22. Hawkins' sign (subchondral bone atrophy in the trochlea) cannot be observed in spite of bone atrophy in tibial side.

the talar body by Hawkins' sign, which is the subchondral bone atrophy of the talar doom (Fig. 2)¹⁰. Avascular necrosis occurred in nine (32%) out of twenty-eight feet but in almost all the cases the revascularization occurred quickly. Deformity of the talus remained in six feet (21%) and the affected foot was smaller of more than 5 mm compared with the opposite side in four cases (14%). All patients except one did not complain any pain during walking and no second procedure was required. Excellent results were achieved in seventeen cases (60%), good results in ten (36%), fair in one (4%) and poor in no case (0%).

DISCUSSION

We could observe two rare sagittal fractures in our series. Nevertheless, we could not find any typical body fracture of which fracture line ran from the medial entrance through the posterior subtalar joint. Typical body fracture may not occur because the body is relatively smaller than the head and neck in children. The flexibility of the body covered by thick cartilage is another reason.

In the neck fractures in adults, almost all fracture lines run on the deepest place of tarsal canal^{11,12,13,14,15}. However, the fractures run on the posterior wall of the sinus talusi in eighteen cases (78%) out of twenty-three neck fractures in this series. This type fracture occur in less than 10% in adults

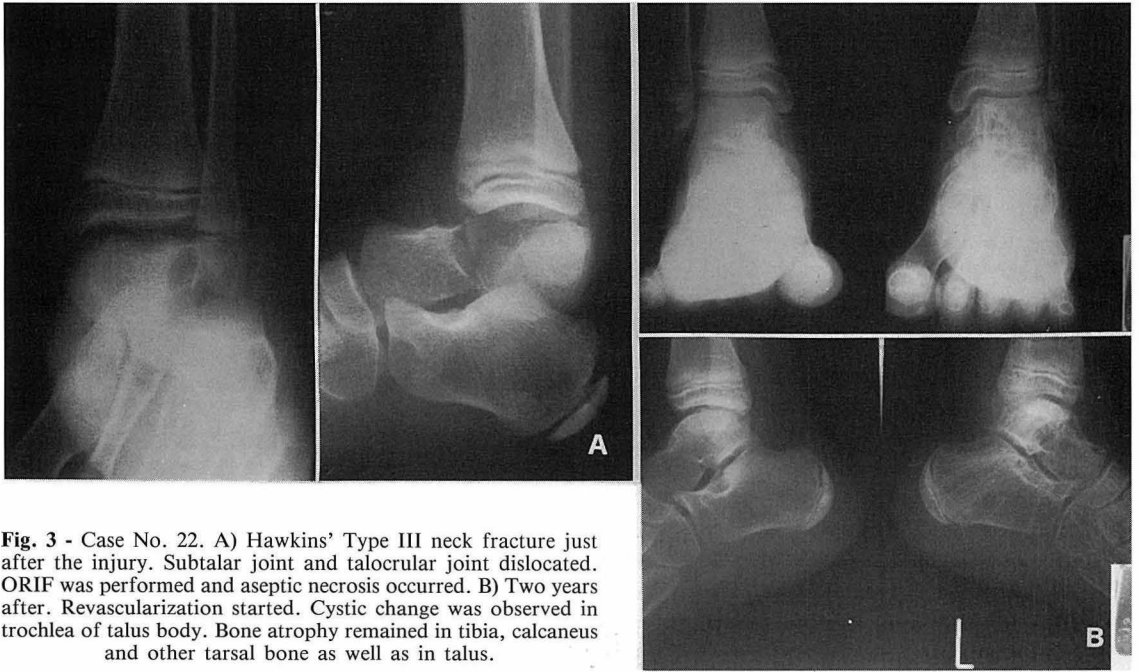


Fig. 3 - Case No. 22. A) Hawkins' Type III neck fracture just after the injury. Subtalar joint and talocrural joint dislocated. ORIF was performed and aseptic necrosis occurred. B) Two years after. Revascularization started. Cystic change was observed in trochlea of talus body. Bone atrophy remained in tibia, calcaneus and other tarsal bone as well as in talus.



Fig. 3 - C) Seven years after. Bone atrophy remained. Joint surface becomes irregular and joint space becomes narrow. Patient complains pain during walking.



Fig. 4 - Case No. 15. A) Hawkins' Type II neck fracture just after injury. ORIF was performed and aseptic necrosis occurred. B) Two years after. Revascularization started partially, but cystic changes were observed. Collapse had not occurred, yet. C) Three years after. Collapse occurred in the medial posterior part of the trochlea. Joint space had been kept.

while it has a high frequency in children. The posterior wall of the sinus talusi may break by the force before the ceiling breaks, because the structure and shape of the ceiling is stronger and more flexible compared with its posterior wall when the sinus talusi is covered with thick cartilage (Fig. 2).

Linhart W.E. and Hollworth M.⁷ showed 51 well-documented cases of talus fractures in childhood reported from 1904 to 1980 in literature together with their own seven cases. They found aseptic necrosis in only one (14%) Type IIB talus fracture of their classification among their own seven cases. There were 22 (38%) aseptic necrosis out of the 58 feet which they reported. There were 9 (32%) aseptic necrosis out of the 28 feet of our cases. Frequency of aseptic necrosis in the total of our cases is similar to cases reported in literature but higher than that in Linhart's cases. Frequency of asep-

tic necrosis was 100% (1/1) in Hawkins' Type III (Fig. 3), 67% (2/3) in Type II (Fig. 4) and 32% (6/19) in Type I (Fig. 5) in our series. The frequency in Hawkins' Type I was higher than that in adults; especially frequency in Type I fractures in children, whose fracture line ran on the posterior wall of sinus talusi was 40% (6/15) and higher than that in adults. The blood flow to the body is stopped by this fracture line, because the insertion of feeding arteries to the talar body together with interosseus ligament remains in the anterior fragment^{16,17}. This type fracture is very characteristic in children and may cause the aseptic necrosis of the talar body. Another cause of aseptic necrosis is that the talar body of children needs higher rate blood supply than the adults one, because of its high metabolism. Usually, revascularization occurs less than six months, earlier than in adults. The col-



Fig. 5 - Case No. 8. A) Hawkins Type I neck fracture. The characteristic fracture line in children. B) Six weeks later the trauma. Aseptic necrosis occurred in spite of no displacement. C) One year after. Revascularization completed, but cystic changes remained. D) Five years after. Recovery completed.

lapse of the talar dome in children may happen more rarely than in adults because of their light body weight. However, the collapse causes the disturbance of the foot growing up as well as degenerative changes like osteoarthritis deformity, bone cyst and bone atrophy.

Fractures of talus are rare especially in children, because talus has no attachment of muscles and tendons which causes indirect force and is protected from direct force by surrounding bones. So, if in facing the fracture of the talus, we should realize that the foot is affected by severe violent force. Soft tissue surrounding the talus can be strongly damaged. The blood supply not only to the talar body but also to the entire foot decreases severely. The fracture, the damage of the soft tissue and the decreasing blood supply disturb the foot growing up. The size of the affected foot is smaller than the opposite foot as well as the size of talus itself, especially in those cases which need surgical treatment.

In spite of the disturbances of growing up and the degenerative changes in bone, joint and soft tissue, the clinical results in children are better than those in adults, because of the light body weight as well as the viability and the resilience. However, the results of severe cases must be worse because of ageing and increasing of patients' body weight in future.

APPENDIX

Our definition of the type of talus fracture

We treated two hundred seventeen cases of major talus fractures from 1975 to 1990 in Keio University Hospital and its participant hospitals. In ninety percent of talus fractures in our series, fracture lines of talus run through the entrance of sinus talusi on the medial edge of the inferior surface of the talus. In two thirds of this group, the fracture lines run throughout sinus talusi to the lateral entrance just anterior to the fibula. We consider this type fracture corresponding to the conventional neck fracture of talus. Another one third of this group corresponds to the conventional body fractures and their fracture line runs throughout the lateral edge of the posterior subtalar joint surface. The conventional definitions of the neck fracture and the body fracture of the talus are not so clear, because their fracture lines overlap each other in the marginal area between the neck and the trochlea of the body on the superior surface of the talus. Therefore, we define the neck fracture as the fracture whose line runs through the sinus talusi. Similarly, we define the body fracture as the fracture whose line runs from the medial entrance of the sinus talusi throughout the lateral edge of the posterior subtalar joint on the inferior surface. In the rest of the group there are the sagittal fracture and the head fracture whose fracture lines do not run through the medial entrance of the sinus talusi on the inferior surface of the talus. We define the sagittal fracture as the fracture whose line runs from the lateral entrance of the sinus talusi throughout the sulcus of the flexor hallucis

longus. The principle of our new classification of the talus fracture focuses on the inferior surface of the talus, and not on its superior surface. The fracture lines of each type of fracture overlap each other on the superior surface of the talus. However, they are separated clearly by lateral and posterior processus, medial tuberculum and head, whose structure is stronger than that of the sinus, the sulcus and the surface of the posterior subtalar joint.

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