

THESIS FOR THE DEGREE OF DOCTOR OF MEDICINE

UNIVERSITY OF EDINBURGH

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REHABILITATION OF FRACTURES OF THE TIBIA AND FIBULA

T A B L E S

by

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**TABLE I**

**CLASSIFICATION OF FRACTURES OF THE ANKLE**

	Mechanistic Classification according to	
	Bormin (1950)	Lauge-Hansen (1950)
<b><u>I SPRAIN FRACTURES</u></b>		
1. Fracture of tip of lateral malleolus	Adduction sprain of calcaneo-fibular ligament	Supination - medial rotation, and supination adduction Stage I
2. Fracture of tip of medial malleolus	Abduction sprain of deltoid ligament	Pronation - abduction and pronation - lateral rotation Stage I
3. Fractures of tip of both medial and lateral malleoli	-	Supination - adduction Stage II
4. Flake fracture of anterior margin of fibula	Inversion - plantar flexion sprain of anterior talo-fibular ligament	-
5. Flake fracture at the insertion of anterior tibiofibular ligament into anterior tubercles of tibia or fibula or both	Lateral rotation sprain of anterior inf. tibiofibular ligament	Supination - lateral rotation Stage I
6. Posterior marginal flake	Calcification of haematoma	-

**II ISOLATED FRACTURES**

1. Fractures of Medial malleolus		
(a) vertical fissure	1st degree adduction fracture	Supination - adduction Stage II with rupture of calcaneo-fibular and posterior talo-fibular ligaments (and sometimes associated flake fractures)
(b) transverse (or slightly oblique)	1st degree abduction fracture	Pronation - abduction and pronation lateral rotation Stage I

(Cont'd.)

**CLASSIFICATION OF FRACTURES OF THE ANKLE  
(CONT'D.)**

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Mechanistic Classification according to  
Bommin (1950) Lauge-Hansen (1950)

**II ISOLATED FRACTURES (Cont.)**

**2. Basal fractures of fibula (below level of the inferior tibiofibular ligaments)**

(a) transverse	1st degree abduction and adduction fractures	Supination - adduction Stage I
(b) oblique: fracture line running laterally and upwards	1st degree abduction fracture	-
(c) vertical fracture of anterior third (Wagstaffe's fracture)	probably a 1st degree lateral rotation fracture	-

**3. Intertubercular or "Mixed Oblique" fractures of the fibula (fracture line oblique helical commencing anteriorly at level of plafond and running upwards and posteriorly between the anterior and posterior tubercles of tibia and fibula)**

(a) undisplaced ("low Dupuytren")	1st degree lateral rotation fracture	Supination - lateral rotation Stage II
(b) with lateral ankle instability due to rupture of anterior inferior tibio-fibular ligament or deltoid ligament	2nd degree lateral rotation fracture	Supination - lateral rotation Stage II
(c) fixation of proximal fragment behind postero-lateral ridge of tibia (Bosworth's fracture-dislocation)	-	-

(cont'd.)

CLASSIFICATION OF FRACTURES OF THE ANKLE  
(CONT'D.)

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Mechanistic Classification according to  
Bormin (1950) Lauge-Hansen (1950)

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II ISOLATED FRACTURES (Cont.)

4. Supratubercular or fractures of the fibula above the level of the tibial articulation, with diastasis, commonly at one of three levels:-

(a) just above the level of anterior and posterior tibial tubercles (transverse or oblique helical)

2nd degree abduction or lateral rotation fractures with diastasis and rupture of deltoid ligament

Pronation - abduction Stage III with rupture of deltoid ligament and undisplaced anterior and posterior marginal flake fractures of tibia

(b) at the junction of lower and middle third of shaft (usually oblique) ("Dupuytren-type")

2nd degree lateral rotation fractures with diastasis and rupture of deltoid ligament

Pronation - lateral rotation Stage III with rupture of deltoid and anterior tibio-fibular ligaments with bone flake from lateral margin of tibia and rupture of interosseous membrane

(c) helical fracture upper third of shaft (Maisonneuve)

1st degree lateral rotation with diastasis or 2nd degree lateral rotation fracture if deltoid ligament ruptures

5. Posterior marginal fracture

1st degree compression fractures

Pronation - abduction Stage II with rupture of deltoid ligament

6. Anterior marginal fracture

CLASSIFICATION OF FRACTURES OF THE ANKLE  
(CONT'D.)

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Mechanistic Classification according to  
Bonnin (1950) Lauge-Hansen (1950)

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**III BIMALLEOLAR FRACTURES**

- |  |  |  |
|--|--|--|
| <p>1. Vertical fissure fracture medial malleolus with transverse fracture of lower end of fibula (up to one inch above level of plafond)</p> | <p>2nd degree adduction fracture</p>   | <p>Supination - adduction Stage II</p>   |
| <p>2. Transverse or oblique fracture of the medial malleolus with:</p>   |  |  |
| <p>(a) transverse or oblique basal fracture of lateral malleolus</p>   | <p>2nd degree abduction fracture</p>   | <p>-</p>   |
| <p>(b) anterior vertical fracture of lateral malleolus</p>   | <p>2nd degree lateral rotation fracture</p>  | <p>-</p>   |
| <p>(c) intertubercular oblique fracture of fibula</p>  | <p>2nd degree lateral rotation fracture</p>  | <p>-</p>   |
| <p>(d) supratubercular fracture of fibula<br/>(1) just above level of tubercles ("Low Dupuytren")</p>  | <p>2nd degree abduction or lateral rotation fracture with diastasis</p>  | <p>Pronation - abduction Stage III (including posterior marginal flake fracture)</p>               |
| <p>(2) in the middle or upper third of shaft ("Dupuytren-type" : Pett)-variation: central dislocation of talus</p>                           | <p>2nd degree lateral rotation fracture with diastasis</p>   | <p>Pronation - lateral rotation fracture Stage III with flake fracture lateral margin of tibia</p> |
| <p>3. Fracture of posterior margin of tibia with:-</p>   |  |  |
| <p>(a) oblique helical inter-tubercular fracture of fibula</p>   | <p>lateral rotation fracture with diastasis<br/>(i) 1st degree or<br/>(ii) 3rd degree if deltoid ligament ruptures</p> | <p>Supination - lateral rotation Stage III</p>   |
| <p>(b) transverse fracture medial malleolus</p>  | <p>-</p>   | <p>Pronation - abduction Stage II</p>  |
| <p>(c) compression fracture of a single malleolus</p>  | <p>2nd degree compression fracture</p>   | <p>-</p>   |

**CLASSIFICATION OF FRACTURES OF THE ANKLE  
(CONT'D.)**

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Mechanistic Classification according to  
Bonin (1950) Lauge-Hansen (1950)

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**IV TRIMALLEOLAR FRACTURES**

- |  |   |   |
|--|---|---|
| 1. Vertical fissure fracture medial malleolus with transverse fracture of lower end of fibula and posterior marginal fracture of tibia | 3rd degree adduction fracture                                     | -   |
| 2. Transverse or oblique fracture of medial malleolus with fractures of the posterior margin or posterior tubercle of the tibia and    |   |   |
| (a) transverse or slightly oblique basal fracture of lateral malleolus   | 3rd degree abduction fracture                                     | -   |
| (b) intertubercular oblique fracture of fibula   | 3rd degree lateral rotation fracture                              | Supination - lateral rotation<br>Stage IV |
| (c) supratubercular fracture of fibula (transverse or oblique)   |   |   |
| (i) just above level of tubercles  | 3rd degree abduction fracture with diastasis                      | Pronation - abduction<br>Stage III        |
| (ii) in the middle or upper third of shaft   | 3rd degree lateral rotation and abduction fracture with diastasis | Pronation - lateral rotation<br>Stage IV  |
- 

**V COMPRESSION FRACTURES OF THE LOWER THIRD OF TIBIA**

- |  |   |  |
|--|---|--|
| (1) T and Y-shaped and spiral fractures into the ankle joint               | } | 3rd degree compression fractures (Bonin) |
| (2) Grossly comminuted fractures of the weightbearing surface of the tibia | } |  |
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**VI EPIPHYSEAL SEPARATIONS**

Classified according to whether the epiphyses are displaced laterally, medially, posteriorly or anteriorly.

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TABLE II

DIAPHYSEAL  
FRACTURESMEAN DURATION OF IMMOBILISATION IN PLASTER AND  
RECOVERY TIME ACCORDING TO FRACTURE SITE

Site of fracture	SIMPLE FRACTURES					
	Series A			Series B		
	No.	Days in plaster	Recovery time (days)	No.	Days in plaster	Recovery time (days)
<u>TIBIA ALONE</u>						
(1) Lower 1/3	1	75	43	8	78	73
(2) Junction of middle & lower 1/3	12	98	(58)			
(3) Middle 1/3	10	91	69	6	81	56
(4) Upper 1/3	0	-	-	2	79	149
(5) Unspecified	1	46	87	12	88	66
<b>TOTAL</b>	<b>24</b>	<b>92</b>	<b>64</b>	<b>28</b>	<b>83</b>	<b>72</b>
<u>TIBIA &amp; FIBULA</u>						
(1) Lower 1/3	2	176	188	0	-	-
(2) Spiral frs. of lower 1/3 tibia & upper 1/3 fibula	4	112	119	5	113	78
(3) Junc. of middle & lower 1/3	16	119	95	17	124	98
(4) Middle 1/3	23	122	79	7	119	88
(5) Upper 1/3	2	99	62	1	78	51
(6) Unspecified	3	106	82	35	129	(88)
<b>TOTAL</b>	<b>50</b>	<b>121</b>	<b>91</b>	<b>65</b>	<b>124</b>	<b>89</b>
<u>BONEGRAFT FRGS. TIBIA &amp; FIBULA</u>						
(1) Lower 1/3	0	-	-	0	-	-
(2) Junction of middle & lower 1/3	1	323	98	0	-	-
(3) Middle 1/3	0	-	-	2	325	123
(4) Middle 1/3 (tibia only)	1	227	128	0	-	-
(5) Upper 1/3	0	-	-	0	-	-
(6) Unspecified	0	-	-	1	292	54
<b>TOTAL</b>	<b>2</b>	<b>275</b>	<b>113</b>	<b>3</b>	<b>314</b>	<b>100</b>

MEAN DURATION OF IMMOBILISATION IN PLASTER AND  
RECOVERY TIME ACCORDING TO FRACTURE SITE

Site of fracture	COMPOUND FRACTURES					
	Series A			Series B		
	No.	Days in plaster	Recovery time (days)	No.	Days in plaster	Recovery time(days)
<u>TIBIA ALONE</u>						
(1) Lower 1/3	0	-	-	0	-	-
(2) Junction of middle & lower 1/3	0	-	-	0	-	-
(3) Middle 1/3	0	-	-	1	104	88
(4) Upper 1/3	1	106	78	0	-	-
(5) Unspecified	0	-	-	2	170	87
<b>TOTAL</b>	<b>1</b>	<b>106</b>	<b>78</b>	<b>3</b>	<b>148</b>	<b>88</b>
<u>TIBIA &amp; FIBULA</u>						
(1) Lower 1/3	4	116	(64)	2	194	146
(2) Spiral frs. of lower 1/3 tibia & upper 1/3 fibula	1	169	(149)	0	-	-
(3) Junc. of middle & lower 1/3	2	132	120	0	-	-
(4) Middle 1/3	8	132	81	2	120	110
(5) Upper 1/3	1	205	144	0	-	-
(6) Unspecified	1	129	59	5	156	(76)
<b>TOTAL</b>	<b>17</b>	<b>134</b>	<b>85</b>	<b>9</b>	<b>156</b>	<b>102</b>
<u>BONEGRAFT FRGS. TIBIA &amp; FIBULA</u>						
(1) Lower 1/3	0	-	-	1	436	119
(2) Junction of middle & lower 1/3	1	268	138	2	445	136
(3) Middle 1/3	1	145	91	0	-	-
(4) Middle 1/3 (tibia only)	0	-	-	0	-	-
(5) Upper 1/3	1	560	101	0	-	-
(6) Unspecified	0	-	-	0	-	-
<b>TOTAL</b>	<b>3</b>	<b>324</b>	<b>110</b>	<b>3</b>	<b>442</b>	<b>130</b>

TABLE III FREQUENCY DISTRIBUTION OF DURATION OF IMMOBILIZATION IN PLASTER ACCORDING TO FRACTURE SITE

Site of Fracture	Number of Patients Grouped According to Duration of Immobilization in Months & Days.																			
	1-28		2-56		3-84		4-112		5-140		6-168		7-196		8-224		9-252		10-280	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
<u>Tibia alone</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(1) Lower 1/3	2	1	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(2) Junction of middle & lower 1/3	1	5	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(3) Middle 1/3	-	6	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(4) Upper 1/3	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(5) Unspecified	1	1	7	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	2	3	12	15	6	6	2	3	1	1	1	1	1	1	1	1	1	1	1	1
<u>Tibia &amp; Fibula</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(1) Lower 1/3	-	-	1	1	2	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
(2) Spiral frs. of lower 1/3 tibia & upper 1/3 fibula	-	1	1	1	2	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
(3) Junction of middle & lower 1/3	-	3	3	5	3	4	7	1	1	1	1	1	1	1	1	1	1	1	1	1
(4) Middle 1/3	1	-	2	5	7	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1
(5) Upper 1/3	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(6) Unspecified	-	-	8	2	10	1	5	1	1	4	4	4	4	4	4	4	4	4	4	4
TOTAL	1	10	15	15	16	12	14	3	8	6	5	1	5	1	2	1	2	1	2	1
<u>Compound fractures</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(1) Lower 1/3	-	2	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(2) Spiral frs. of lower 1/3 tibia & upper 1/3 fibula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(3) Junction of middle & lower 1/3	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
(4) Middle 1/3	-	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(5) Upper 1/3	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(6) Unspecified	-	-	-	-	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	-	3	1	5	3	3	3	2	2	3	1	1	1	1	1	1	1	1	1	1

(267 & 304 days)

(274 days)

(294 days)

**TABLE IV RATE OF UNION AND INCIDENCE OF DELAYED UNION AND NON-UNION**

Type of fracture	Total number of patients in each group	Number & percentage of patients having had plaster removed and commenced mobilization:-						Number & percentage of patients requiring bonegraft			
		by 12 weeks		by 16 weeks		by 20 weeks			by 24 weeks		
		No.	(%)	No.	(%)	No.	(%)		No.	(%)	
<u>Tibia alone</u> Series A	25	14	(56)	20	(80)	22	(88)	22	(88)	1	(4)
Series B	28	18	(64.3)	24	(85.7)	27	(96.4)	28	(100)	-	-
Both series	53	32	(60.4)	44	(83)	49	(92.5)	50	(94.3)	1	(2)
<u>Simple fractures tibia &amp; fibula</u> Series A	51	11	(21.6)	26	(51)	38	(74.5)	41	(80.4)	1	(2)
Series B	68	15	(22)	31	(45.6)	45	(63.2)	53	(78)	3	(4)
Both series	119	26	(21.8)	57	(47.9)	83	(69.7)	94	(79)	4	(3)
<u>Compound fractures tibia &amp; fibula</u> Series A	21	3	(14)	8	(38)	11	(52)	13	(62)	3	(14)
Series B	15	1	(7)	4	(27)	7	(47)	9	(60)	3	(20)
Both series	36	4	(11)	12	(33)	18	(50)	22	(61)	6	(17)
		Number & percentage of patients in both series showing delayed union:-									
		at 12 weeks		at 16 weeks		at 20 weeks		at 24 weeks		Number & percentage of patients requiring bonegraft	
		No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Tibia alone	53	21	(39.6)	9	(17)	4	(7.5)	3	(5.7)	1	(2)
Simple fractures of tibia & fibula	119	93	(78.2)	62	(52.1)	36	(30.3)	25	(21)	4	(3)
Compound fractures of tibia & fibula	36	32	(89)	24	(67)	18	(50)	14	(39)	6	(17)

\* on 84th., 112th., 140th. and 168th. day respectively.

TABLE VI. INCIDENCE OF VARIOUS TYPES OF ACCIDENT (SERIES A)

Type of Accident	Number of patients sustaining:-					Total
	Fracture tibia	Fracture tibia and fibula	Compound fractures	Bonegraft fractures		
<u>Road Accidents</u>						
(1) Motor car or service transport	1	2	1	-	4	
(2) Motor cycle	3	8	6	2	19	
(3) Pedal cycle	-	-	1	-	1	
(4) Pedestrian	-	2	1	1	4	
<u>Sport Injuries</u>						
(1) Soccer	14	27	3	2	46	
(2) Rugger	-	2	1	-	3	
(3) Gymnastics	1	2	1	-	4	
(4) Water Polo	1	-	-	-	1	
<u>Assault Course Accidents</u>	-	3	1	-	4	
<u>Falls or Slips</u>	2	3	2	-	7	
<u>Crushed under Armoured Hatch</u>	-	-	1	-	1	
<u>Trapped by Packing Cases</u>	-	1	-	-	1	
Not recorded	2	-	-	-	2	
<b>TOTAL</b>	<b>24</b>	<b>50</b>	<b>18</b>	<b>5</b>	<b>97</b>	

TABLE VI MEAN DURATION OF IMMOBILIZATION ACCORDING TO AGE OF PATIENTS

Age Group (years)	Series	Simple fractures of tibia			Simple fractures of tibia & fibula			Compound fractures			Bonegraft fractures		
		No.	Days in plaster	Recovery time (days)	No.	Days in plaster	Recovery time (days)	No.	Days in plaster	Recovery time (days)	No.	Days in plaster	Recovery time (days)
16-19	A	10	74	57	24	110	97	8	126	84	1	268	138
	B	16	84	73	18	109	(80)	4	176	(97)	1	175	88
20-24	A	13	106	(73)	20	128	80.5	4	150	107	2	234	95
	B	8	82	57	26	128	(75)	5	122	79	1	436	172
25-47	A	1	101	23	6	146	103	6	130	(65)	2	393	115
	B	4	81	95	21	132	113	3	181	131	4	414	107
16-19	A+B	26	80	67	42	109	(88)	12	142	(87)	2	222	113
	A+B	21	97	(66)	46	128	(78)	9	134	92	3	301	120
25-47	A+B	5	85	80	27	135	111	9	147	(93)	6	407	110

The brackets indicate that in arriving at the figure, one patient has been excluded from the group for reasons stated in the text, except for compound fractures in the 25-47 age group (series A), where two patients have been excluded.

**TABLE VII EFFECT OF METHODS OF REDUCTION AND FIXATION ON MEAN DURATION OF IMMOBILIZATION AND RECOVERY TIME.**

Method of reduction and fixation	Series A			Series B		
	No. of patients	Days in plaster	Recovery time (days)	No. of patients.	Days in plaster	Recovery time (days)
<u>Fractures of tibia</u>						
(1) <u>Reduction completed during first week</u> (General anaesthetic required for 3 fractures; screwed 1; plated 1)	20	84	(64)	7	74	58
(2) <u>Fractures disturbed after first week</u> (General anaesthetic required for 2 fractures; screwed 1)	3	112	48	-	-	-
(3) <u>Skeletal traction</u>	1	198	105	1	127	119
<u>Fractures of tibia and fibula</u>						
(1) <u>Reduction completed during first week</u> (a) plaster only (General anaesthetic required for 9 fractures in each series)	17	97	66	9	111	94
(b) screwed	3	87	69	5	108	87
(c) plated	1	172	153	2	118	98
(d) inlay bone graft	-	-	-	1	159	49
(e) double fr. plaster only	1	165	92	-	-	-
Total	22	102	72	17	114	90
(2) <u>Fractures disturbed after first week</u> (a) further manipulation or wedging	10	140	78	6	111	93
(b) screwed	3	188	204	1	125	115
(c) plated	6	121	91	4	152	88
(d) Kuntscher nail	3	127	116	-	-	-
Total	22	139	104	11	127	93
(3) <u>Skeletal traction</u>	6	125	117	3	171	140
<u>Compound fractures</u>						
(1) <u>Reduction completed during first week</u> (a) plaster only (General anaesthetic required for 6 fractures)	6	149	(97)	1	97	51
(b) screwed	2	86	88	-	-	-
(2) <u>Fracture disturbed after first week</u> (a) further manipulation or wedging	3	139	93	-	-	-
(b) plated	4	111	51	1	138	165
(3) <u>Skeletal traction</u>	3	155	(106)	3	154	102

**TABLE VIII** COMPARISON OF THE EFFECTS OF OPEN AND CLOSED REDUCTION ON DURATION OF IMMOBILIZATION IN PLASTER AND RECOVERY TIME.

Method of Reduction	Series A			Series B		
	No. of patients	Days in plaster	Recovery time (days)	No. of patients	Days in plaster	Recovery time (days)
<u>Simple fractures of tibia and fibula</u>						
(a) closed	28	114	71	15	111	93
(b) open	16	131	117	13	128	88
(c) skeletal traction	6	125	117	3	171	140
<u>Compound fractures of tibia and fibula</u>						
	Series A and B					
	No. of patients	Days in plaster	Recovery time (days)			
(a) closed	10 (9)	141	(91)			
(b) open	7	108	79			
(c) skeletal traction	6	154	103			

TABLE IXA EFFECT OF EXERCISES AT M.R.U. WHILE IN PLASTER ON MEAN RECOVERY TIME  
(SERIES A), ACCORDING TO TYPE OF FRACTURE

Type of Fracture	No. of patients	Mean time at M.R.U. in plaster (days)	Mean total duration in plaster (days)	Mean delay time (days)	Recovery time (days)	Mean total treatment time (days)
<u>Simple fractures of tibia</u>						
1. Patients treated at M.R.U. in plaster						
(a) undisplaced fractures	7	32	72	-	41	113
(b) displaced fractures	7	30	96	-	63	159
both groups	14	31	84	-	52	136
2. Patients not treated at M.R.U. while in plaster						
(a) undisplaced fractures	4	-	75	17	56	131
(b) displaced fractures	4	-	116	49	101	217
both groups	8	-	96	33	78	174
<u>Simple fractures of tibia and fibula</u>						
1. Patients treated at M.R.U. in plaster						
(a) immediate reduction	11	49	99	-	68	167
(b) reduction delayed or corrected after 7 days.	13	48	113	-	85	198
both groups including fractures treated by skeletal traction(3)	27	48	107	-	82	189
2. Patients not treated at M.R.U. while in plaster						
(a) immediate reduction	9	-	94	14	63	157
(b) reduction delayed or corrected after 7 days.	8	-	166	19	135	300
both groups including fractures treated by skeletal traction(3)	20	-	129	18	99	228
<u>Compound fractures</u>						
1. Patients treated at M.R.U. in plaster						
	9	58	151	-	99	250
2. Patients not treated at M.R.U. while in plaster.						
	7	-	98	15	67	165

(Cont'd.)

TABLE IXA (CONT'D.)

EFFECT OF EXERCISES AT M.R.U. WHILE IN PLASTER ON  
MEAN RECOVERY TIME (SERIES A), ACCORDING TO  
TYPE OF FRACTURE.

Type of Fracture	No. of patients	Mean time at M.R.U. in plaster (days)	Mean total duration in plaster (days)	Mean delay time (days)	Recovery time (days)	Mean total treatment time(days)
<u>Fractures immobilized in caliper after plaster had been removed</u>						
1. Simple fractures of tibia	1	29	198	-	105	303
2. Simple fractures of tibia and fibula						
(a) treated at M.R.U. in plaster	2	87	220	-	130	349
(b) not treated at M.R.U. in plaster	1	-	133	5	113	246
3. Bonegraft fractures	2	42	248	-	133	381

**TABLE IXB EFFECT OF EXERCISES AT M.R.U. WHILE IN PLASTER ON MEAN RECOVERY TIME (SERIES B), ACCORDING TO TYPE OF FRACTURE**

Type of Fracture	No. of patients	Mean time at M.R.U. in plaster (days)	Mean total duration in plaster (days)	Mean delay time (days)	Recovery time (days)	Mean total treatment time(days)
<u>Simple fractures of tibia</u>						
1. Patients treated at M.R.U. in plaster	21	43	85	-	63	148
2. Patients not treated at M.R.U. in plaster	6	-	74	30	83	157
<u>Simple fractures of tibia and fibula</u>						
1. Patients treated at M.R.U. in plaster						
(a) immediate reduction	7	53	100	-	70	170
(b) reduction delayed or corrected after 7 days	6	57	130	-	71	201
(c) treatment not specified	18	40	121	-	80	201
all groups including fractures treated by skeletal traction(1)	32	46	119	-	78	197
2. Patients not treated at M.R.U. while in plaster						
(a) immediate reduction	10	-	123	36	103	226
(b) reduction delayed or corrected after 7 days	4	-	112	40	118	230
(c) treatment not specified	14	-	118	17	86	204
all groups including fractures treated by skeletal traction(2)	30	-	124	27	99	223
<u>Compound fractures</u>						
1. Patients treated at M.R.U. in plaster	5	39	151	-	94	245
2. Patients not treated at M.R.U. while in plaster	6	-	133	29	102	235

(Cont'd.)

TABLE IXB (CONT'D)

EFFECT OF EXERCISES AT M.R.U. WHILE IN PLASTER ON  
MEAN RECOVERY TIME (SERIES B), ACCORDING TO TYPE OF  
FRACTURE

Type of Fracture	No. of patients	Mean time at M.R.U. in plaster (days)	Mean total duration in plaster (days)	Mean delay time (days)	Recovery time (days)	Mean total treatment time (days)
<u>Bonegraft fractures</u>						
1. Patients treated at M.R.U. in plaster	2	148	464	-	128	592
2. Patients not treated at M.R.U. in plaster	4	-	335	-	108	443
<u>Fractures immobilised in caliper after plaster had been removed</u>						
1. Simple fractures of tibia	1	-	92	43	194	286
2. Simple fractures of tibia and fibula.	1	107	173	-	126	299
3. Compound fracture tibia and fibula.	1	132	294	-	202	496

**TABLE IX C** EFFECT OF EXERCISES AT M.R.U. WHILE IN PLASTER ON MEAN RECOVERY TIME (BOTH SERIES) ACCORDING TO TYPE OF FRACTURE

Type of Fracture	No. of patients	Mean time at M.R.U. in plaster (days)	Mean total duration in plaster (days)	Mean delay time (days)	Recovery time (days)	Mean total treatment time(days)
<u>Simple fractures of tibia</u>						
1. Patients treated at M.R.U. in plaster	35	38	85	-	58	143
2. Patients not treated at M.R.U. in plaster	14	-	87	32	80	167
<u>Simple fractures of tibia and fibula</u>						
1. Patients treated at M.R.U. in plaster	59	47	113	-	80	193
2. Patients not treated at M.R.U. in plaster	50	-	126	26	99	225
<u>Compound fractures</u>						
1. Patients treated at M.R.U. in plaster	14	52	151	-	97	248
2. Patients not treated at M.R.U. while in plaster	13	-	114	20	83	197
<u>All types of Fracture treated at M.R.U. in plaster</u>						
(a) series A	50	45	109	-	76	185
(b) series B	58	44	109		74	183
<u>All types of Fracture not treated at M.R.U. in plaster</u>						
(a) series A	35	-	115	21	88	203
(b) series B	42	-	118	28	97	215

(Cont'd.)

TABLE IX C (CONT'D.)

EFFECT OF EXERCISES AT M.R.U. WHILE IN PLASTER ON MEAN  
RECOVERY TIME (BOTH SERIES) ACCORDING TO TYPE  
OF FRACTURE

Type of Fracture	No. of patients	Mean time at M.R.U. in plaster (days)	Mean total duration in plaster (days)	Mean delay time (days)	Recovery time (days)	Mean total treatment time (days)
Total both series all fractures treated at M.R.U. in plaster*	108	45	109	-	75	184
Total both series all fractures not treated at M.R.U. in plaster*	77	-	117	26	93	210

\*

Excluding patients subsequently treated in a caliper or requiring bonegraft.

**TABLE X EFFECT OF DURATION OF IMMOBILIZATION IN PLASTER AND EXERCISES AT M.R.U. IN PLASTER ON MEAN RECOVERY TIME.**

(a) Fractures Immobilized in Plaster for 44 - 84 days:-										
Patients treated at M.R.U. while in plaster					Patients not treated at M.R.U. while in plaster					
Time at M.R.U. in plaster (groups)	Series	No. of patients	Mean duration in days of		Total treatment time	Delay in arrival at M.R.U. after plaster removed	Series	No. of patients	Mean duration in days of	
			Time at M.R.U. in plaster	Total period in plaster					Total period in plaster at M.R.U.	Recovery time
Over 28 days	A	10	43	74	125	0-21 days	A	6	71	53
	B	13	40	68	132	0-21 days	B	6	78	78
5-28 days	A	9	15	72	136	Over 21 days	A	2	65	79
	B	9	18	75	141	Over 21 days	B	7	64	86
(b) Fractures Immobilized for 85 - 112 days:-										
Over 28 days	A	7	50	102	172	0-21 days	A	10	97	53
	B	13	57	101	162	0-21 days	B	6	89	64
5-28 days	A	4	11	97	195	Over 21 days	A	5	96	74
	B	1	20	112	159	Over 21 days	B	4	105	133
(c) Fractures Immobilized for 113 - 168 days:-										
Over 28 days	A	14	65	130	201	0-21 days	A	3	125	67
	B	12	68	133	216	0-21 days	B	6	157	77
5-28 days	A	1	9	121	197	Over 21 days	A	3	127	149
	B	4	19	132	235	Over 21 days	B	7	138	134

**TABLE XI** EFFECT OF DURATION OF IMMOBILIZATION IN PLASTER ON MEAN RECOVERY TIME (BOTH SERIES)

Plaster Immobilization Group	Number of patients	Mean time at M.R.U. in plaster (days)	Mean total period in plaster (days)	Recovery time (days)	Mean total treatment time(days)
<b>(1) Patients treated at M.R.U. <u>while in plaster</u></b>					
(a) 44-84 days	41	30	72	61	133
(b) 85-112 days	25	46	101	69	170
(c) 113-168 days	31	58	131	80	211
(d) 169-304 days	11	56	202	128	330
<b>(2) Patients not treated at M.R.U. <u>in plaster</u></b>					
		Mean delay in arrival at M.R.U. (days)			
(a) 44-84 days	21	19	70	74	144
(b) 85-112 days	25	21	96	73	169
(c) 113-168 days	19	32	134	108	242
(d) 169-249 days	12	32	215	146	361

**TABLE XII** EFFECT OF EXERCISES AT M.R.U. IN PLASTER ON RECOVERY TIME  
ACCORDING TO TIME OF ARRIVAL

Time of Arrival at M.R.U.	No. of patients	Mean time at M.R.U. in plaster, or mean delay in arrival at M.R.U. (+) (days)	Mean total period in plaster (days)	Recovery time (days)	Mean total treatment time(days)
<b>(1) All shaft fractures series A</b>					
(a) over 28 days at M.R.U. in plaster	36	57	119	77	196
(b) 5-28 days at M.R.U. in plaster	14	14	83	75	158
(c) 0-21 days after plaster off	21	10(+)	103	70	173
(d) over 21 days after plaster off	14	38(+)	133	115	248
<b>(2) All shaft fractures series B *</b>					
(a) over 28 days at M.R.U. in plaster	42	54	110	71	181
(b) 5-28 days at M.R.U. in plaster	16	18	108	81	189
(c) 0-21 days after plaster off	22	9(+)	122	81	203
(d) over 21 days after plaster off	20	49(+)	113	115	229
<b>(3) All shaft fractures both series *</b>					
(a) over 28 days at M.R.U. in plaster	78	56	114	74	188
(b) 5-28 days at M.R.U. in plaster	30	16	96	78	174
(c) 0-21 days after plaster off	43	9(+)	113	75	188
(d) over 21 days after plaster off	34	44(+)	122	115	237

\* Excluding patients subsequently treated in a caliper or requiring bonegraft.

CONTINGENCY ANALYSIS. TABLE XII.

The significance of association of the means of the recovery times and total treatment times in the four groups a, b, c and d has been tested by construction of  $2 \times n$  contingency tables for the number of the recovery times (R) above and below 75 days, and of the total treatment times (T) above and below 180 days.

Comparing groups a, b and c:-

Series A,  $\chi^2$  for R = 1.72,  $\chi^2$  for T = 1.77  
 Series B,  $\chi^2$  for R = 1.59,  $\chi^2$  for T = 0.37  
 Both Series  $\chi^2$  for R = 0.43,  $\chi^2$  for T = 0.24

For P = 0.05, n = 2,  $\chi^2 = 5.99$ . There is therefore no significant association between the means of these groups.

Comparing groups a + b + c with d:-

Series A,  $\chi^2$  for R = 7.21,  $\chi^2$  for T = 1.73  
 Series B,  $\chi^2$  for R = 8.41,  $\chi^2$  for T = 7.30  
 Both Series,  $\chi^2$  for R =  $\frac{7}{8}$  16.03,  $\chi^2$  for T = 8.43

For P = 0.05, n = 1,  $\chi^2 = 3.84$ . There is a significant relationship between groups a, b and c combined and group d, except with regard to the mean total treatment times in Series A, which is influenced by increased plaster times in group (a)

Comparing group c in Series A and B, the maximum difference between the two Series was tested by including the number of means of recovery time (R1) above and below 85 days and total treatment times (T1) above and below 200 days.

$\chi^2$  for R1 = 4.34, T1 = 5.56

For P = 0.05, n = 1,  $\chi^2 = 3.84$ . The relationship between Series A and B in group c is significant, but should be interpreted with caution in view of the difference in mean plaster times between the two groups.

**TABLE XIII MALLEOLAR FRACTURES: INFLUENCE OF FRACTURE SITE ON MEAN DURATION OF IMMOBILIZATION AND RECOVERY TIME (SERIES A)**

Type and Site of Fracture	No. of patients	Time in plaster (days)	Recovery time (days)	Total treatment time (days)
<b>I Sprain Fractures</b>				
(1) Avulsion tip of lateral malleolus	1	17	54	71
(2) Avulsion tip of medial malleolus	1	34	15	49
(3) Avulsion tip of both medial and lateral malleoli	2	29	42	71
(4) Posterior marginal flake	2	19	29	48
Total	6	24	35	59
<b>II Isolated Fractures ("Unimalleolar")</b>				
(1) Fractures of medial malleolus				
(a) Vertical fissure	1	55	31	86
(b) Transverse - oblique	6	63	41	104
Total	7	61	40	101
(2) Basal fractures of fibula	0	-	-	-
(3) Intertubercular ("mixed oblique") fractures of fibula	15	39	57	96
(4) Supratubercular fractures of fibula				
(a) Low oblique	2	52	73	125
(b) At the junction of middle and lower third of shaft - "Pott-Dupuytren-type"	2	62	46	108
- "Helical"-mixed oblique" type	1	93	62	155
Total all supratubercular fractures	5	64	60	124
Total all fibular fractures	20	45	58	103
(5) Posterior marginal fractures	1	68	84	152
(6) Anterior marginal fractures	0	-	-	-
Total all isolated fractures	28	50	55	105
<b>III Bimalleolar Fractures</b>				
(1) Vertical fissure fracture of medial malleolus and transverse fracture of distal end of fibula	3	87	64	151
(2) Transverse-oblique fractures of medial malleolus with				
(a) Low oblique supratubercular fracture of fibula	1	148	67	215
(b) Oblique fracture at junction of lower and middle third of shaft of fibula "Dupuytren-type"	1	21	189	210
Total all fractures of medial and lateral malleoli	7	87	103	190

(Cont'd.)

**TABLE XIII (Cont'd) MALLEOLAR FRACTURES: INFLUENCE OF FRACTURE SITE ON MEAN DURATION OF IMMOBILIZATION AND RECOVERY TIME (SERIES A)**

Type and site of fracture.	No. of patients	Time in plaster (days)	Recovery time (days)	Total treatment time (days)
(3) Fracture of posterior margin of tibia with				
(a) Intertubercular fracture of fibula	2	60	73	133
(b) Supratubercular fracture of fibula				
(oblique and helical fractures at junction of middle and lower third of shaft)	4	53	82	135
Total all fractures lateral and posterior malleoli (site not recorded in one fracture)	7	56	79	135
Total all bimalleolar fractures	14	71	92	163
<b>IV. <u>Trimalleolar Fractures</u></b>				
Transverse fracture of medial malleolus and posterior marginal fracture with:				
(a) Intertubercular fracture of fibula	2	54	87	141
(b) Comminuted supratubercular fracture of fibula at junction of middle and lower third of shaft ("Pott-Dupuytren type")	1	58	90	148
Site not recorded.	1	93	169	262
Total all trimalleolar fractures.	4	65	108	173
<b>V <u>Compression Fractures</u></b>				
(1) Comminuted oblique fracture of middle third of tibia with extension into ankle joint and vertical fracture of medial malleolus and supratubercular fracture of lateral malleolus	1	110	67	177
(2) Vertical fissure fracture of medial malleolus and transverse basal fracture of fibula; comminution of anterior margin of tibia	1	Arthrodesis at 171 days		
<b>VI <u>Epiphyseal Separation Fractures</u></b>				
(1) Fracture-separation of lower fibula epiphysis	1	38	14	52
(2) Fracture-separation of lower tibial epiphysis with				
(a) Lateral displacement	2	42	39	81
(b) Posterior displacement and diaphyseal flake	2	62	57	119
Total all epiphyseal separation fractures	5	49	41	90
<b>VII <u>Miscellaneous</u></b>				
(1) Intertubercular fracture of fibia complicated by osteochondritis dessicans of talus in recovery stage	1	20	245	265
(2) Fracture fibula with psychiatric complications	1	70	-	-

**TABLE XIV MALLEOLAR FRACTURES ; INFLUENCE OF TYPE OF FRACTURE ON MEAN DURATION OF IMMOBILIZATION AND RECOVERY TIME (SERIES A AND B)**

Type of Fracture	Series A			Series B			
	No. of patients	Time in plaster (days)	Recovery time (days)	Total treatment time (days)	No. of patients in plaster (days)	Recovery time (days)	Total treatment time (days)
<b>I Sprain Fractures</b>							
(1) Avulsion tip of lateral malleolus	1	17	54	71	4	27	69
(2) Avulsion tip of medial malleolus	1	34	15	49	1	53	90
(3) Avulsion tip of both medial and lateral malleoli	2	29	42	71	1	18	69
(4) Posterior marginal flake	2	19	29	48	0	-	-
Total	6	24	35	59	6	29	72
<b>II Isolated Fractures</b>							
(1) Fractures of medial malleolus	7	61	40	101	10	63	121
(2) Intertubercular fractures of fibula	15	39	57	96	-	-	-
(3) Supratubercular fractures of fibula	5	64	60	124	3	67	114
Total all fibular fractures	20	45	58	103	42	(52)	(99)
(4) Posterior marginal fractures	1	68	84	152	2	38	95
(5) Anterior marginal fractures	0	-	-	-	1	113	180
Total all isolated fractures	28	50	55	105	55	(55)	(105)
<b>III Bimalleolar Fractures</b>							
(1) Fractures of medial and lateral malleoli	7	87	103	190	3	61	144
(2) Fractures of posterior margin of tibia with lateral malleolus	7	56	79	135	6	84	145
Total	14	72	91	163	9	77	145
<b>IV Trimalleolar Fractures</b>							
	4	65	108	173	3	87	146

(Cont'd.)

TABLE XIV (CONT'D.) MALLEOLAR FRACTURES : INFLUENCE OF TYPE OF FRACTURE ON MEAN DURATION OF IMMOBILIZATION AND RECOVERY TIME (SERIES A AND B)

Type of Fracture	Series A			Series B				
	No. of patients	Time in plaster (days)	Recovery time (days)	Total treatment time (days)	No. of patients	Time in plaster (days)	Recovery time (days)	Total treatment time (days)
<u>V Compression Fractures</u>								
(1) Spiral fractures of tibia involving ankle joint and both malleoli	1	110	67	177	1	131	199	330
(2) Spiral fracture of tibia involving ankle joint	-	-	-	-	1	240	176	416
(3) Trimalleolar fracture arthrodesed	1	-	-	-	0	-	-	-
<u>VI Epiphyseal Separations</u>								
(1) Fracture-separation lower fibular epiphysis	1	38	14	52	1	35	60	95
(2) Fracture-separation lower tibial epiphysis	4	52	48	100	3	56	57	113
VII Miscellaneous (see text and Table XIII)	2	-	-	-	3	-	-	-

∞ indicates that the figures are available only for the 3 fractures of this type recorded in this series.

TABLE XV . MALLEOLAR FRACTURES: INCIDENCE OF VARIOUS TYPES OF ACCIDENTSERIES A.

Type of Accident	Number of Patients	Percentage	Percentage Incidence in Diaphyseal Fractures
<u>Road Accidents</u>			
1. Vehicle (in all cases when jumping or alighting from vehicles)	3	5%	4%
2. Motor cycle	5	8%	20%
3. Pedestrian	0	0	4%
<u>Sports Injuries</u>			
1. Soccer	13	21%	47%
2. Rugger	8	13%	3%
3. Gymnastics including Judo	5	8%	4%
4. Basket ball	2		
5. Ice skating	1		
<u>Assault Course Accidents</u>			
	4		
<u>Parachute Jumping</u>			
	2		
<u>Falls or Slips</u>			
1. While walking or running	8	} 21%	7%
2. Down steps or ladder	5		
<u>Turning during Drill</u>			
	1		
<u>Blows on Foot (cable and hangar door respectively)</u>			
	2		
<u>Air Craft Crash (ground victim)</u>			
	1		
<u>Kicked</u>			
	1		
	61	-	-

**TABLE XVI** MALLEOLAR FRACTURES: MEAN DURATION OF IMMOBILIZATION AND TOTAL TREATMENT TIME ACCORDING TO AGE OF PATIENTS.

Age Group (Years)	Series	Isolated Fractures			Bimalleolar and Trimalleolar Fractures		
		No.	Days in plaster	Total treatment time (days)	No.	Days in plaster	Total treatment time (days)
17 - 19	A	14	42	100	7	62	143
	B	25	48	106	4	65	115
20 - 24	A	12	59	107	8	82	173
	B	18	55	(102)	2	48	116
25 - 44	A	2	56	120	3	55	196
	B	12	46	107	6	73	175
17 - 19	Combined A and B	39	46	104	11	63	133
20 - 24	"	30	57	(104)	10	74	161
25 - 44	"	14	47	109	9	67	182

The figures in brackets indicate that one patient has been excluded from these totals, since recovery was unduly prolonged on account of a posterior tibial nerve palsy.

**TABLE XVII MALLEOLAR FRACTURES: EFFECT OF DURATION OF IMMOBILIZATION IN PLASTER AND EXERCISES AT M.R.U. IN PLASTER ON MEAN RECOVERY TIME**

(a) Fractures Immobilized in Plaster for 9 - 49 days:-						Patients not treated at M.R.U. in plaster									
Patients treated at M.R.U. in plaster			Patients not treated at M.R.U. in plaster			Patients not treated at M.R.U. in plaster			Patients not treated at M.R.U. in plaster						
Time at M.R.U. in plaster (groups)	Series	No. of patients	Mean Duration in Days of		Delay in arrival at M.R.U. after plaster removed	Series	No. of patients	Mean Duration in Days of		Delay in arrival at M.R.U. at M.R.U.	Series	No. of patients	Mean Duration in Days of		
			Time at M.R.U. in plaster	Total period in plaster				Total treatment time	Recovery time				Total time in plaster	Recovery time	Total treatment time
Over 28 days	A	0	-	-	0-14 days	A	9	37	4	29	A	9	37	4	66
	B	7	35	45	84	B	9	37	7	53	B	9	37	7	89
5-28 days	A	12	15	35	80x	A	5	30	31	89	A	5	30	31	119
	B	17	16	37	73	B	7	41	22	67	B	7	41	22	108
(b) Fractures Immobilized in Plaster for 50 - 112 days:-															
Over 28 days	A	7	50	79	153	A	8	67	6	63	A	8	67	6	131
	B	9	40	64	101	B	10	69	5	75	B	10	69	5	143
5-28 days	A	9	18	66	130	A	6	68	31	102	A	6	68	31	170
	B	7	19	67	116	B	10	65	47	107	B	10	65	47	173

z If a patient whose recovery was prolonged on account of post-traumatic pes valgus associated with subtaloid arthritis is excluded from this group, the recovery time for the group falls to 38 days and total treatment time to 74 days.

TABLE XVIII

MALLEOLAR FRACTURES: EFFECT OF DURATION OF IMMOBILIZATION IN PLASTER ON MEAN RECOVERY TIME (SERIES A AND B COMBINED)

Plaster immobilization group	Number of patients	Mean time at M.R.U. in plaster (days)	Mean total period in plaster (days)	Recovery time (days)	Mean total treatment time (days)
(1) Patients treated at M.R.U. <u>in plaster</u>					
(a) 9 - 49 days	36	19	38	39	77
(b) 50 - 112 days	32	31	69	55	124
(2) Patients not treated at M.R.U. <u>in plaster</u>		Mean delay in arrival at M.R.U. (days)			
(a) 9 - 49 days	30	14	37	55	92
(b) 50 - 112 days	34	24	67	87	154

TABLE XIX MALLEOLAR FRACTURES: EFFECT OF EXERCISES IN PLASTER ON RECOVERY TIME ACCORDING TO TIME OF ARRIVAL AT M.R.U.

Time of arrival at M.R.U.	Number of patients	Mean time at M.R.U. in plaster, or mean delay in arrival at M.R.U. (+) (days)	Mean total period in plaster (days)	Recovery time (days)	Mean total treatment time (days)
<u>All Malleolar Fractures both Series</u>					
(a) Over 28 days in plaster at M.R.U.	23	41	63	49	112
(b) 5-28 days at M.R.U. in plaster.	45	17	47	46	93
(c) 0-14 days after plaster removed	36	6(+)	52	55	107
(d) Over 14 days after plaster removed	28	37(+)	53	93	146

Contingency analysis: method as for Table XII, recording the number of the recovery times (R) above and below 50 days and of the total treatment times (T) above and below 105 days

Comparing groups a, b and c:-

$$\chi^2 \text{ for R} = 1.73, \chi^2 \text{ for T} = 1.72$$

For  $P = 0.05$ ,  $n = 2$ ,  $\chi^2 = 5.99$ . There is therefore no significant association between the means of these groups.

Comparing groups a + b + c with d:-

$$\chi^2 \text{ for R} = 16.64, \chi^2 \text{ for T} = 12.88$$

For  $P = 0.05$ ,  $n = 1$ ,  $\chi^2 = 3.84$ . There is a significant relationship between groups a, b and c combined and group d.

**TABLE XX**      **DIAPHYSEAL FRACTURES: MEAN RANGE OF KNEE AND ANKLE JOINT MOVEMENT**  
**ON REMOVAL OF PLASTER AT M. R. U.**

Duration of immobilization in plaster	Number of patients	Knee extension (degrees)	Knee flexion (degrees)	Ankle dorsiflexion (degrees)	Ankle plantar flexion (degrees)
(1) Up to 84 days (mean 72.5 days)	13	171	111	89	128
(2) 85-112 days (mean 101.4 days)	8	173	123	89	117
(3) 113-168 days (mean 130.0 days)	14	174	122	87	123
(4) 169-267 days (mean 208.0 days)	6	171	131	89	123

TABLE XXI

DIAPHYSEAL FRACTURES: RATE OF RECOVERY OF KNEE FLEXION FOLLOWING  
INCREASING PERIODS OF IMMOBILIZATION IN PLASTER

The recovery of knee flexion has been estimated by recording the number of patients, who had reached each stage of knee flexion at the end of each week after removal of the plaster.

Plaster immobilization group and degree of knee flexion	Number of patients												
	1st. week	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	On discharge
<b>Under 84 days in plaster</b>													
Over 90°	3	-	-	-	-	-	-	-	-	-	-	-	-
71° - 90°	3	2	-	-	-	-	-	-	-	-	-	-	-
51° - 70°	9	2	2	1	1	1	-	-	-	-	-	-	-
41° - 50°	4	13	8	6	4	3	3	3	3	3	3	3	3
Under 40°	-	2	9	12	14	15	16	16	16	16	16	16	16
Total 19 patients													
<b>85 - 112 days in plaster</b>													
Over 90°	5	2	-	-	-	-	-	-	-	-	-	-	-
71° - 90°	2	2	1	-	-	-	-	-	-	-	-	-	-
51° - 70°	2	4	4	4	3	2	1	1	-	-	-	-	-
41° - 50°	1	1	4	4	4	5	4	4	4	3	3	3	2
Under 40°	1	2	2	3	4	4	6	6	7	8	8	8	9
Total 11 patients													
<b>113 - 168 days in plaster</b>													
Over 90°	8	3	-	-	-	-	-	-	-	-	-	-	-
71° - 90°	4	4	4	1	-	-	-	-	-	-	-	-	-
51° - 70°	1	5	7	2	2	2	2	1	1	1	1	1	1
41° - 50°	2	1	2	7	7	7	5	5	4	4	3	2	2
Under 40°	-	2	2	5	6	6	8	9	10	10	11	12	12
Total 15 patients													
<b>169 - 267 days in plaster</b>													
Over 90°	8	8	6	4	2	1	-	-	-	-	-	-	-
71° - 90°	1	1	2	3	4	4	1	1	1	-	-	-	-
51° - 70°	-	-	1	2	1	2	6	5	5	5	4	3	2
41° - 50°	-	-	-	-	2	2	2	3	3	3	4	5	6
Under 40°	-	-	-	-	-	-	-	-	-	1	1	1	1
Total 9 patients													

TABLE XXII

DIAPHYSEAL FRACTURES: RATE OF RECOVERY OF KNEE AND ANKLE JOINT FUNCTION IN HALF (50%) AND THE MAJORITY OF PATIENTS (90%) AFTER INCREASING PERIODS OF IMMOBILIZATION

Degree of movement	Week in which half (50%) and the majority of patients (90%) attained the corresponding degree of movement. Total number of patients in first column of each group.											
	Up to 84 days in plaster			85 - 112 days			113 - 168 days			169 - 267 days		
<u>Knee flexion</u>	No.	50%	90%	No.	50%	90%	No.	50%	90%	No.	50%	90%
90°	19	1	2	11	1	3	15	2	3	9	4	6
70°	19	1	2	11	2	3	15	2	4	9	7	7
50°	19	2	3	11	3	7	14	4	7	7	10	(12+)
40°	16	3	(7+)	9	7	(10+)	12	7	(12+)	1	-	-
<u>Ankle dorsi-flexion</u>												
90°	18	1	1	11	1	3	15	1	2	9	1	3
85°	17	1	3	10	2	6	15	2	4	9	1	7
80°	16	1	9	7	6	-	14	4	11	6	9	-
75°	9	7	-	5	-	-	8	(16)	-	2	-	-
<u>Ankle plantar flexion</u>												
120°	18	1	1	11	1	5	15	1	2	9	1	1
125°	18	1	2	11	1	9	15	1	4	9	1	3
130°	18	1	8	10	3	12	14	2	8	8	2	5
135°	16	1	11	6	3	-	14	4	11	8	5	11
140°	14	3	-	5	(9)	-	7	(11)	-	4	(15+)	-

The figures in brackets are approximate. As the extreme range of movement is reached the number of patients in each group is reduced, but the figures for 50% and 90% of patients relate to the original total.

TABLE XXIII

DIAPHYSEAL AND MALLEOLAR FRACTURES: RANGE OF SUPINATION AND PRONATION ON REMOVAL OF PLASTER AT M.R.U.

Duration of immobilization in plaster	Number of patients showing 1/4, 1/2, 3/4, over 3/4 and full range of movement compared with normal foot									
	Supination					Pronation				
	1/4	1/2	3/4	Over 3/4	Full	1/4	1/2	3/4	Over 3/4	Full
<b>Diaphyseal fractures</b>										
(1) Up to 84 days (mean 72.5 days)	2	6	3	2	-	-	3	6	3	1
(2) 85-112 days (mean 101.4 days)	4	2	2	-	-	3	2	2	-	1
(3) 113-168 days (mean 130 days)	4	3	5	1	1	2	3	4	2	3
(4) Over 169 days (mean 208 days)	2	2	-	2	-	3	2	-	1	-
<b>Total</b>	<b>12</b>	<b>13</b>	<b>10</b>	<b>5</b>	<b>1</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>6</b>	<b>5</b>
<b>Malleolar fractures</b>										
(1) Isolated inter-tubercular fractures	1	4	2	1	-	-	3	-	4	1
(2) Isolated supra-tubercular fractures and fractures of medial malleolus	1	1	1	3	1	-	-	2	4	1
(3) Bimalleolar and trimalleolar fractures	1	1	3	-	-	-	2	1	2	-
<b>Total</b>	<b>3</b>	<b>6</b>	<b>6</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>3</b>	<b>10</b>	<b>2</b>
(4) All ankle fractures immobilized for less than 49 days	2	4	2	3	1	-	3	1	5	3
(5) All ankle fractures immobilized for more than 49 days	2	4	4	4	1	-	4	3	7	1
<b>Total all ankle fractures</b>	<b>4</b>	<b>8</b>	<b>6</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>7</b>	<b>4</b>	<b>12</b>	<b>4</b>

**TABLE XXIV**

**MALLEOLAR FRACTURES: MEAN RANGE OF ANKLE MOVEMENT ON REMOVAL OF PLASTER  
AT M. R. U.**

Type of fracture	Number of patients	Mean plaster time (days)	Ankle dorsiflexion (degrees)	Ankle plantar flexion (degrees)
1. Isolated intertubercular fractures of fibula	8	41	87	120
2. Isolated supratubercular fractures of fibula, fractures of medial and posterior malleoli	7	64	86	125
3. Bimalleolar and trimalleolar fractures	5	69	89	121
All ankle fractures immobilized under 49 days in plaster	12	35	85	125
All ankle fractures over 49 days in plaster	15	70	87	124

**TABLE XXV MALLEOLAR FRACTURES : RATE OF RECOVERY OF ANKLE JOINT FUNCTION IN HALF (50%) AND THE MAJORITY OF PATIENTS (90%) AFTER REMOVAL OF PLASTER AT M.R.U.**

Degree of movement	Week in which half (50%) and the majority of patients (90%) attained the corresponding degree of movement. Total number of patients recorded in first column of each group.								
	Intertubercular fractures			Isolated supratubercular fractures and fractures of medial and posterior malleoli			Bimalleolar and trimalleolar fractures		
	No.	50%	90%	No.	50%	90%	No.	50%	90%
<u>Ankle dorsiflexion</u>									
90°	8	1	1	7	1	4	7	1	2
85°	8	1	4	7	1	6	7	2	4
80°	8	1	13	6	1	(11)	6	5	(10)
75°	3	-	-	4	9	-	3	-	-
<u>Ankle plantar flexion</u>									
120°	8	1	1	7	1	1	7	1	2
125°	8	1	2	7	1	8	7	1	6
130°	8	1	5	7	4	9	6	3	-
135°	8	2	6	5	6	-	6	4	-
140°	5	6	-	3	-	-	3	-	-
	All ankle fractures immobilized under 49 days			All ankle fractures immobilized over 49 days			Uni-, Bi- and Tri-malleolar fractures		
<u>Ankle dorsiflexion</u>	No.	50%	90%	No.	50%	90%	No.	50%	90%
90°	12	1	1	17	1	2	22	1	2
85°	12	1	1	17	1	4	22	1	4
80°	12	1	6	15	2	(11)	20	2	13
75°	6	5	-	9	12	-	10	(12)	-
<u>Ankle plantar flexion</u>									
120°	12	1	1	17	1	2	22	1	1
125°	12	1	1	17	1	6	22	1	3
130°	12	1	3	16	1	9	21	2	6
135°	11	1	7	13	6	-	19	5	(12)
140°	9	2	-	6	-	-	11	16	-

( ) see footnote Table XXII.

**TABLE XXVI MEAN RATES OF RECOVERY OF WALKING, RUNNING AND ABILITY TO STAND ON TOES FOLLOWING DIAPHYSEAL FRACTURES**

The symbols used in Tables XXVI - XXVIII indicate the mean time in days from the removal of plaster to the time the patients are able to perform the following tests of function :-

- W1 : to walk with even steps and minimal limp,  
 W2 : to walk normally in the consultation room,  
 R : to run with even steps and minimal limp,  
 S1 : to be just able to stand on the toes of the injured leg without support,  
 S2 : to be readily able to stand on the toes of the injured leg without support.

Plaster immobilization group	Number of patients	Mean plaster time (days)	W1	W2	R	S1	S2
<b>Diaphyseal fractures immobilized for under 4 months (112 days)</b>							
(1) Patients treated for more than 28 days in plaster at M.R.U.	13	85	30.5	48.5+	52	29	34
(2) Patients treated for less than 28 days in plaster at M.R.U.	13	76.5	31	57+	48	32	43
(3) Patients arriving at M.R.U. up to 21 days after removal of plaster	14	89.5	33	48+	46+	30	43+
<b>All diaphyseal fractures</b>							
(1) Patients treated over 28 days in plaster at M.R.U.	31	121	41	68+	62+	44	55
(2) Patients treated for less than 28 days in plaster at M.R.U.	15	87	37	58	49	37	53
(3) Patients arriving at M.R.U. up to 21 days after removal of plaster	17	101	34.5	50.5+	48	31	42+
(4) Patients arriving at M.R.U. more than 21 days after removal of plaster	11	148	90+	96+	106+	64+	87.5+
<b>Diaphyseal fractures immobilized for more than 4 months (112 days) and treated for more than 28 days at M.R.U. in plaster</b>	18	146.5	49	84+	69+	55	70

**TABLE XXVII** EFFECT ON RATE OF RECOVERY OF WALKING, RUNNING AND ABILITY TO STAND ON TOES OF INCREASING PERIODS OF IMMOBILIZATION IN PLASTER IN (a) DIAPHYSEAL FRACTURES (b) MALLEOLAR FRACTURES AND (c) INFLUENCE OF TYPE OF MALLEOLAR FRACTURE IN PATIENTS TREATED AT THE M.R.U. IN PLASTER.

For symbols used see Table XXVI - XXVIII

Plaster immobilization group	Number of patients	Mean plaster time (days)	W1	W2	R	SI	S2
<b>(a)</b> <u>Diaphyseal fractures treated at M.R.U. in plaster and immobilized</u> --							
(1) up to 3 months (84 days)	17	72	31	46+	45	27	38
(2) 3-4 months (85 - 112 days)	9	97	30.5	69+	59	37.5	46+
(3) 4-6 months (113-168 days)	15	129	40	65+	62	40	55
(4) over 6 months	5	202	88	(146+)	102	102	135
<b>Total</b>	<b>46</b>	<b>110</b>	<b>40</b>	<b>64+</b>	<b>58+</b>	<b>42</b>	<b>54.5</b>
<b>(b)</b> <u>Malleolar fractures treated at M.R.U. in plaster and immobilized</u> --							
(1) up to 7 weeks (49 days)	14	36	19	27	27	19	25
(2) over 7 weeks (50-110 days)	17	71	36	54	50	31	44
<b>(c)</b> <u>Type of ankle fracture treated in plaster at M.R.U. :-</u>							
(1) sprain fractures	3	30	18	20	25	18	26
(2) isolated intertubercular fractures	9	41	27	39	36	24	33
(3) isolated supratubercular fractures and fractures of medial malleolus	6	64	31.5	45	42	29	37
(4) bimalleolar fractures	6	70	27	51	51	28	43
(5) epiphyseal separation fractures	4	48.5	22	30.5	28	15	23
(6) miscellaneous	3	-	-	-	-	-	-
<b>Total</b>	<b>31</b>	<b>55</b>	<b>28</b>	<b>42</b>	<b>39</b>	<b>26</b>	<b>35</b>

**TABLE XXVIII** EFFECT OF EXERCISES IN PLASTER AND DELAY IN ARRIVAL ON RATE OF RECOVERY OF WALKING, RUNNING AND ABILITY TO STAND ON TOES IN MALLEOLAR FRACTURES.

For symbols used see Table XXVI

Plaster immobilization group	Number of patients	Mean plaster time (days)	W1	W2	R	S1	S2
<u>Malleolar fractures immobilized for over 7 weeks (50 days)</u>							
(1) patients treated for more than 28 days in plaster at M.R.U.	7	79	30	54	52	25	40
(2) patients treated for less than 28 days in plaster at M.R.U.	10	65	40	54	48	36	47
(3) patients arriving at M.R.U. up to 14 days after removal of plaster	6	72	39	51+	49	34	48
(4) patients arriving at M.R.U. more than 14 days after removal of plaster	4	63	73	61	84	59	86
<u>All malleolar fractures</u>							
(1) all patients treated at M.R.U. in plaster	31	55	28	42	39	26	35
(2) patients arriving up to 14 days after removal of plaster	10	58	33	42+	41	28	40
(3) patients arriving more than 14 days after removal of plaster	9	55	67	72	83	55	77

For "All Malleolar Fractures" the significance of association of the means of W1 and S2 in the three groups has been tested by construction of 2 x n contingency tables for the number of the values of W1 above and below 28 days, and of S2 above and below 35 days.

Comparing groups 1 and 2,  $\chi^2$  for W1 = 0.27, for S2 = 0.15.

Comparing groups 1 + 2 and 3,  $\chi^2$  for W1 = 11.91, for S2 = 4.82.

For P = 0.05, n = 1,  $\chi^2 = 3.84$ . There is therefore no significant association between the means of groups 1 and 2, but there is a significant relationship between the means of groups 1 and 2 combined and group 3.

List of books suggested for inclusion in  
N.O.C. Library

For consideration at Library Committee Meeting on Jan. 27th.

- Reprints from Artificial limbs. From 1954 to date.  
Dept. Med. & Surg. Veterans Admin. 1970
- B.M.A. Planning Unit. Computers in medicine. 5/-  
B.M.A. 1969
- Blakemore, W.S. & Pitts, W.T. Management of the injured patient.  
Hoerber Med. Div. 1969 p370 \$14.50. Review in B.M.J. 27th Dec.
- Campbell, P.N. & Greville, G.D. Essays in biochemistry vol.5. 1969 30/-  
Acad. Press. suggested by Dr. Francis.
- Cawley, L.P. Electrophoresis and immuno electrophoresis.  
Churchill 1969 360p 125/-
- Clayton, E.B. Electrotherapy & acknotherapy  
6th ed. 1969 40/-
- Colson, J.H.C. Progressive exercise therapy in rehabilitation and physical  
education. 1969 30/- 2nd. ed. 207p. Wright.
- Conn, H.J. Biological stains. 8th ed. by Little, R.D. 1969 498p  
Williams & Willans. 140/- suggested by Mr. Haynes.
- Cyriax, J. Textbook of orthopaedic medicine. Diagnosis of soft tissue  
lesions. vol. 1 5th ed. Bailliers, Tindall, & Cassell 1969 116/-
- Dubowitz, V. The floppy infant. Spashesht. Med. Pub. with Heineman  
Med. Books. 1969 109p 42/6
- Eckert, C. Emergency room care.  
Churchill. 1969 373p 75/- good review in B.M.J. 13th Dec.
- Florey. General pathology. 4th ed. 1970 1259p. 160/-  
Lloyd Luke. We have 3rd. ed. 1964
- Calen on the usefulness of the parts of the body. May, M.T. translater  
vol. 1 & 2 p461 463-802.  
Cornell Univ. Press. N.Y. 1968 238/-
- Great teachers of Surgery in the past. A collection of articles from  
Brit. J. Surg. 1964-68. Wright 1969 37/6 147p
- Ham, A.W. Histology 1969 6thed.  
Lippincott. \$18 1037p
- Haywood, B.J. Electrophoresis: technical applications; a bibliography  
of abstracts.  
Ann Arber-Humphrey Science Pubs. 1969 440p. Ann Arber, Rich