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Management of Sport-Related Fractures: Operative Versus Non-Operative Management

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Abstract

Background: Fractures are the most serious injury suffered by athletes, resulting in the greatest time recuperating from Such injuries.
Objectives: To describe the difference in outcome for non-operative versus operative management of site-specific soccer-related fractures.
Methods: All fractures sustained during soccer from 2007 to 2008 within the Lothian population were prospectively recorded. Patients were followed up in August 2010, via telephone, to determine return rates and times to soccer. High incidence fractures with significant rates of surgery (Tibial Diaphysis, Ankle, Scaphoid, Clavicle, Metacarpus Distal Radius) were identified and classified according to the AO system. Outcomes of similar fracture classifications with contrasting management were compared.
Results: Of 367 fractures identified during the study period, 20% were managed operatively. The rates of surgery for the six fractures cohorts were Tibial Diaphyseal 67%, Ankle 51%, Scaphoid 25%, Clavicle 20%, Metacarpal 11% and Distal Radial 10%. Operatively managed fractures of the Distal Radius (14 weeks vs. 9 weeks: $P < 0.031$), Ankle (42 weeks vs. 22 weeks: $P < 0.004$) and Metacarpus (18 weeks vs. 5 weeks: $P < 0.001$) took longer to return to soccer than non-operatively managed fractures, while operatively managed fractures of the Tibial Diaphysis took shorter to return (35 weeks vs. 45 weeks: $P = 0.673$). Operatively managed fractures of the Ankle (57% vs. 22%: $P < 0.029$), Tibial Diaphysis (89% vs. 50%: $P = 0.683$), Scaphoid (80% vs. 60%: $P = 0.613$), Clavicle (50% vs. 31%: $P = 0.584$), Distal Radius (50% vs. 18%: $P = 0.234$) and Metacarpus (67% vs. 40%: $P = 0.537$) had higher rates of persisting symptoms at follow-up than non-operatively managed fractures.
Conclusions: The role of operative management in the treatment of soccer-related fractures is specific to the location and nature of the fracture. The effect of operative management on return times to sport is fracture specific, though invariably this is associated with higher rates of persisting symptoms. The decision regarding the choice of non-operative versus operative management requires clinical judgment on an individual basis, based on the fracture location and configuration.

Keywords: Fracture, Sport, Soccer, Return, Time, Operative, Non-Operative

1. Background

Fractures remain one of the most serious injuries suffered by athletes, resulting in considerable time away from sport, with significant rates of persisting symptoms post-treatment (1-5). Despite their significant morbidty, there remains considerable variation in their management, due to various factors such as clinician preference and experience, difference in availability of resources and variation in patient desires and expectations (6, 7). Given the significant adverse economic and social implications these injuries can have, both from professional and amateur sport, appropriate knowledge of the optimal management strategies for sport-related fractures is a key factor in modern day sports medicine (1-5).

The management of sport-related fractures is guided the standard treatment principles of orthopaedic trauma, based on fracture location, configuration and displacement (8). There is however a growing body of literature that promotes a tailored choice of fracture management based on the activity level of the patient (9-13). Athletic patients with undisplaced 'unstable' fractures may benefit from primary surgical management to avoid the deconditioning associated with cast management and to promote earlier return to sporting activities (9-13). Such examples include surgical management of undisplaced scaphoid waist fractures, undisplaced tibial shaft fractures

and undisplaced 5th metatarsal base fractures (9-13). These principles, however, are site-specific, with other undisplaced 'stable' fractures, such as those of the ankle, being better managed with orthotic immobilisation and early rehabilitation, (5, 9). The literature guiding such principles remains limited, and further evidence is required in this field to optimise practice (9). As young athletic patients often have good quality bone with significant potential for fracture healing, when managed either operatively or non-operatively (14, 15), clear guidelines should be available to direct optimal management on individual fracture types to allow rapid return to sport as possible with the lowest side effect profile.

2. Objectives

This study analyses a cohort of fractures sustained by soccer players, at all levels, within a standard UK population, over the period of a year. Fractures are divided by body part and then by AO fracture classification as well as by mode of management (operative vs. non-operative). Comparisons are made between return times and rates to soccer and persisting symptoms at follow-up for similar fracture types managed operatively and non-operatively.

3. Methods

3.1. Study Design

All acute fractures sustained within the Edinburgh, Mid and East Lothian populations from July 2007 to July 2008 in patients aged 15 years was prospectively recorded in a database. The population count for Edinburgh, Mid and East Lothian was 517,555. Information contained within the database included age, gender, mode of injury, and site and nature of the fracture. Fracture classification was performed using the AO (Arbeitsgemeinschaft fuer Osteosynthesefragen) classification, by individual review of each presenting radiograph by an orthopaedic surgeon. The Gustilo classification was used to classify open fractures (16). For fractures sustained during sport, the type of sport performed was recorded in the database. The database did not record stress fractures. Non-resident individuals were excluded from the database.

All patients who sustained a fracture during soccer were identified from the database and telephoned in August 2010 to complete a standardised questionnaire. This provided mean follow-up of 30 months post-fracture (range 24 to 36 months).

All the case notes of the patient cohort were retrospectively reviewed in August 2010 to determine fracture treatment modalities and subsequent complications, particularly noting the development of non-union or mal-union.

The six fracture locations with the highest rates of surgery (tibial diaphysis, ankle, scaphoid, clavicle, distal radius and metacarpal) were categorised by the AO Classification to differentiate the site and type of these fractures. Operative management was defined as fractures requiring surgical fixation while non-operative management was defined as not requiring surgical fixation. Manipulation under anaesthetic (MUA) and casting was considered non-operative management. Comparisons were made between similar fracture types that were managed operatively or non-operatively with a focus on time and rate of return to soccer, persisting symptoms post-injury, non-union and mal-union.

3.2. Statistical Analysis

Analysis of the cohort data was performed using SPSS 22.0 (SPSS, Chicago, Illinois, USA). For continuous data, univariate comparisons were performed with the Student t-test and multivariate comparisons with the ANOVA. For categorical data, uni-variate comparisons were performed with the Chi Squared Test (using Fisher's exact test if necessary). The significance level was $P < 0.05$.

4. Results

Over the study period, 367 soccer-related fractures were recorded in 357 patients.

Twenty percent of the fractures required surgical management (n = 72). Surgical intervention included Open Reduction Internal Fixation (65%), Intra-Medullary Nailing (17%), External Fixation (8%) and K-Wire Fixation (6%). The common fracture locations with the highest rates of surgery were tibial diaphysis (67%), ankle (51%), scaphoid (25%), clavicle (20%), metacarpal (11%) and distal radius (10%).

Of the 250 upper limb fractures, 11% were managed surgically (Table 1). Of the 117 lower limb fractures, 38% were managed surgically (Table 2). The percentage of surgery for each fracture type is shown in Tables 1 and 2.

Fractures with high rates of MUA and casting included distal radius (16%) and finger phalanx (13%).

All surgically managed tibial diaphyseal fractures were treated with IM Nail (n = 12). All surgically managed ankle fractures were treated with ORIF (n = 25); 10 of those required syndesmosis screw fixation. Of the four surgically managed clavicle fractures, one (mid-shaft) was treated with plate fixation and three (all lateral) were treated with open endobutton fixation. Of the three surgically managed metacarpal fractures, one was treated with plate fixation and two with MUA and K-Wiring. From the distal radial cohort, three fractures were managed with volar plate fixation and four with Non-Bridging External Fixation. From

Table 1. Upper Limb Fracture Outcome Data[a]

Type	No.	Follow-Up	Surgically Managed	Return Surgical	Return Non Surgical	Time to Return Surgical, wks	Time to Return Non Surgical, wks
Total	250	209 (84)	23 (11.0)	18 (78.3)	160 (86)	19.7[b]	8.0[b]
Finger Phalanx	76	62 (82)	2 (3.2)	2 (100)	57 (95)	13.0[b]	6.4[b]
Distal Radius	73	62 (85)	6 (9.7)	4 (66.7)	45 (80)	14.0[b]	8.5[b]
Metacarpal	27	23 (85)	3 (13.0)	3 (100)	17 (85)	18.3[b]	4.6[b]
Scaphoid	24	20 (83)	5 (25)	4 (80)	14 (93.3)	Acute: 8.5, Delayed: 40	12.7
Clavicle	20	17 (85)	4 (23.5)	3 (75)	10 (76.9)	22.3	16.8
Proximal Radius	17	14 (82)	1 (7.1)	1 (100)	11 (84.6)	7.0	7.9
Proximal Humerus	2	2 (100)	0 (0)	-	1 (50)	-	6.0
Radial Diaphysis	2	2 (100)	0 (0)	-	1 (50)	-	8.0
Ulna Diaphysis	2	2 (100)	0 (0)	-	1 (50)	-	28.0
Radius and Ulna	2	1 (50)	1 (100)	1 (50)	-	16.0	-
Distal Humerus	1	1 (100)	1 (100)	1 (100)	-	6.0	-
Humeral Diaphysis	1	1 (100)	0 (0)	-	1 (100)	-	24.0
Proximal Ulna	1	0 (0)	-	-	-	-	-
Capitate	1	1 (100)	-	-	1 (100)	6.0	-
Triquetrum	1	1 (100)	-	-	1 (100)	6.0	-

[a]Values are expressed as No. (%).
[b]$P < 0.05$

Table 2. Lower Limb Fracture Outcome Data[a]

Type	No.	Follow-Up	Surgically Managed	Return Rate Surgical	Return Rate Non Surgical	Time to Return Surgical, wks	Time to Return Non Surgical, wks
Total	117	103 (88)	36 (35.0)	30 (83.3)	59 (88.1)	42.3[b]	18.4[b]
Ankle	49	44 (90)	21 (47.7)	19 (90.5)	23 (100.0)	42.0[b]	22.2[b]
Metatarsal	23	21 (91)	0(0)	-	20 (95)	-	11.5
Tibial Diaphysis	18	15 (83)	9 (60.0)	8 (88.9)	4 (66.7)	35.0	44.5
Toe	8	6 (75)	0(0)	-	3 (50)	-	7.0
Distal Tibia	4	4 (100)	3 (75.0)	2 (66.7)	1 (100.0)	80.0	36.0
Fibula	4	4 (100)	0 (0)	-	3 (75)	-	11.0
Talus	3	3 (100)	0 (0)	-	2 (67)	-	29.0
Midfoot	2	2 (100)	0 (0)	-	1 (50)	-	32.0
Proximal Tibia	2	2 (100)	2 (100)	1 (50)	-	32.0	-
Patella	2	1 (50)	1 (100)	0 (0)	-	-	-
Sesamoid	2	2 (100)	0(0)	-	2 (100)		6.0

[a]Values are expressed as No. (%).
[b]$P < 0.05$

the scaphoid cohort, two acute fractures were managed with Percutaneous Screw fixation and four delayed unions underwent ORIF (3 requiring bone graft).

Of the patients managed operatively (n = 72), six (8%) suffered complications from surgery. These included three post-operative compartment syndromes (all tibial diaphyseal fractures), two post-operative wound infections following (one ankle fracture, one scaphoid fracture), and one bilateral pulmonary emboli (tibial diaphyseal fracture).

Ten patients (14%) required secondary surgery, which included post-operative fasciotomies for tibial diaphyseal fractures (n = 3), exchange nail for tibial non-union (n = 1), removal of metalwork from prominent locking screws in a tibial nail (n = 1), removal of symptomatic clavicle plate (n = 1), removal of symptomatic patella cerclage wire (n = 1), removal of infected scaphoid screw (n = 1), revision ankle fixation for initial malreduction (n = 1), removal of symptomatic ankle syndesmosis screw (n = 1).

Full follow-up data was obtained for 312 (85%) of the fractures. Of these, 267 (86%) returned to soccer. Patients returned to pre-injury level of soccer at mean duration of 15 weeks (range 0 - 104 weeks; SD 16.6 weeks). Table 3 shows the return times to soccer for the six major fracture locations, comparing outcome by displacement of fracture, comminution of fracture and age of patient.

Regarding the location of ankle fractures, Weber A fractures (n = 9) took a mean of 22.8 weeks to return to full level soccer (operatively managed (n = 2), mean time to return 38 weeks: non-operatively managed (n = 7), mean time to return 18 weeks), Weber B fractures (n = 23) a mean of 32.9 weeks to return to full level soccer (operatively managed (n = 10), mean time to return 46 weeks: non-operatively managed (n = 13), mean time to return 24 weeks) and Weber C fractures (n = 10) a mean of 34.9 weeks to return to full level soccer (operatively managed (n = 7), mean time to return 38 weeks: non-operatively managed (n = 3), mean time to return 23 weeks). Comparison between time to return for Weber A, B and C fractures was not significant (P = 0.412).

Regarding the location of clavicle fractures: mid shaft fractures (n = 7) took a mean of 18.9 weeks to return to full level soccer (undisplaced non-operatively managed (n = 4), mean time to return 12.5 weeks: displaced non-operatively managed (n = 2), mean time to return 29.0 weeks; displaced operatively managed (ORIF) (n = 1), mean time to return 24 weeks); lateral fractures (n = 6) took a mean of 17.2 weeks to return to full level soccer (displaced operatively managed (open endobutton fixation) (n = 2), mean time to return 21.5 weeks: undisplaced non-operatively managed (n = 4), mean time to return 15 weeks).

For scaphoid fractures, those treated with acute percutaneous fixation had a return time of 8.5 weeks (n = 2); those treated with casting had a return time of 12.7 weeks (n = 14); those treated with casting, who later developed non-union and required ORIF had a return time of 40 weeks (n = 2).

For distal radial fractures, those treated with cast alone had a return time of 8.3 weeks (n = 42); those requiring MUA and Cast had a return time of 11.7 weeks (n = 3). Those managed surgically had a return time of 14 weeks (n = 4); those who underwent immediate surgery had a return time of 12 weeks (n = 3); those who underwent delayed surgery following displacement with initial cast management had a return time of 16 weeks (n = 1). Those treated with ORIF had a return time of 10.7 weeks (n = 3); those with Non-Bridging External Fixation had a return time of 24 weeks (n = 1).

For metacarpal fractures, those treated with MUA and K-Wiring had a return time of 21.5 weeks (n = 2); those treated with ORIF had a return time of 12 weeks (n = 1).

Figure 1A to 1F shows the Ankle, Tibial Diaphyseal, Clavicle, Distal Radial, Metacarpal and Scaphoid Fracture cohorts respectively divided by AO Classification, with each subgroup divided into those managed operatively and non-operatively.

From the six cohorts, Salter Harris Fracture Patterns were observed within two of these (Distal Radial and Ankle). There were seven cases within the Distal Radial cohort (1 Salter Harris I, 5 Salter Harris II, 1 Salter Harris III) and three cases within the Ankle cohort (1 Salter Harris I, 1 Salter Harris II, 1 Salter Harris IV).

Table 4 shows the rate of persisting symptoms for the six major fracture types by displacement of fracture, comminution of fracture and age of patient. Higher rates of persisting symptoms were seen in the operative cohorts of all the fractures types.

Overall, 45 (14%) of the fracture patients had not returned to soccer two years post-injury. The return rates for each of the fracture types, by surgical and non-surgical treatment, is shown in Tables 1 and 2.

For the whole cohort, the rate of non-union was 1.3% (4/312) and the rate of mal union was 3.8% (12/312). The rates of non-union, mal-union and delayed union for the six fracture cohorts are listed in Table 5.

5. Discussion

We believe this is the first paper to provide a comprehensive description of the variation in management of soccer-related fractures and the effect this has on return to sport and persisting symptoms. Despite the massive global interest in the sport, and the substantial monetary value associated with it (17, 18), there remains very little published evidence on management of soccer-related fractures and subsequent function (18-23). Given the importance of such outcomes, this data would prove very useful in guiding management of injured soccer players.

The currently available literature analyses combined cohorts of sport and soccer fractures, failing to take account of the influence of fracture site and severity on outcome (3, 24). The evidence suggests that operatively managed fractures take longer to return to full level sport and have higher rates of persisting symptoms but this is likely influenced more severe fractures and lower limb fractures

Table 3. Time to Return by Severity of Fracture and Patient Age (wks)

Type	Time to Return Displaced	Time to Return Non-Displaced	Time to Return Comminuted	Time to Return Non-Comminuted	Time to Return Over 30	Time to Return Under 30
Upper Limb						
Clavicle	25.0[a]	13.8[a]	24.0	17.6	30.3[a]	12.7[a]
Distal Radius	13.0[a]	8.3[a]	12.7[a]	8.4[a]	11.4[a]	8.1[a]
Metacarpal	18.3[a]	4.6[a]	5.3	6.9	7.0	6.7
Scaphoid	-	15.3	-	15.3	22.4	12.5
Lower Limb						
Ankle	42.0[a]	22.2[a]	38.4[a]	21.5[a]	44.7[a]	27.5[a]
Tibial Diaphysis	35.0	44.5	40.0	38.0	40.0	38.0

[a] $P < 0.05$.

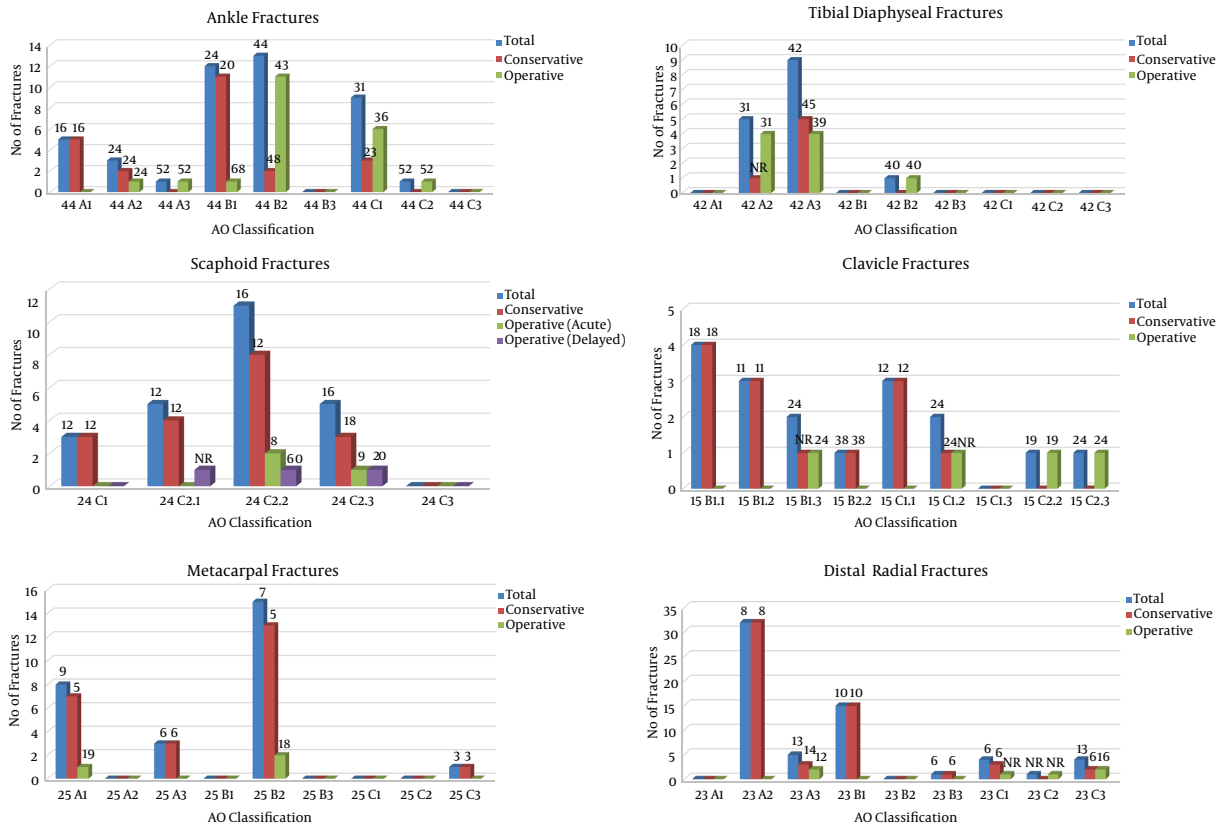

Figure 1. A, The Ankle Fracture Cohort divided by AO Classification and Management. (The duration to return to full level soccer (weeks) is noted at the top of each bar.); B, The Tibial Diaphyseal Fracture Cohort divided by AO Classification and Management. (The duration to return to full level soccer (weeks) is noted at the top of each bar.); C, The Scaphoid Fracture Cohort divided by AO Classification and Management. (The duration to return to full level soccer (weeks) is noted at the top of each bar.); D, The Clavicle Fracture Cohort divided by AO Classification and Management. (The duration to return to full level soccer (weeks) is noted at the top of each bar.); E, The Metacarpal Fracture Cohort divided by AO Classification and Management. (The duration to return to full level soccer (weeks) is noted at the top of each bar.); F, The Distal Radial Fracture Cohort divided by AO Classification and Management. (The duration to return to full level soccer (weeks) is noted at the top of each bar.).

having higher rates of surgery (3). Such injuries often have prolonged rehabilitation and higher likelihood of persisting problems given the greater nature of structural damage involved (3, 8). An in-depth assessment of site-specific

Table 4. Persisting Symptoms by Managed and Severity of Fracture[a]

Type	Persisting Symptoms	Persisting Symptoms Surgical: Non Surgical	Persisting Symptoms Displaced: Non-Displaced	Persisting Symptoms Comminuted: Non Comminuted	Persisting Symptoms Over 30: Under 30
Upper Limb					
Clavicle	6 (35)	2 (50): 4 (31)	3 (43): 3 (30)	0 (0): 6 (38)	1 (20): 5 (42)
Distal Radius	13 (21)	3 (50):10 (18)	5 (50): 8 (15)[b]	4 (40): 9 (17)	6 (29): 7 (17)
Metacarpal	10 (43)	2 (67): 8 (40)	2 (67): 8 (40)	1 (33): 9 (45)	2 (50): 8 (42)
Scaphoid	13 (65)	4 (80): 9 (60)	13 (65): 0 (0)	13 (65): 0 (0)	8 (57): 5 (83)
Lower Limb					
Ankle	17 (39)	12 (57): 5 (22)[b]	12 (57): 5 (22)[b]	15 (58): 2 (11)[b]	9 (82): 8 (24)
Tibial Diaphysis	11 (73)	8 (89): 3 (50)	8 (89): 3 (50)	1 (100): 10 (71)	2 (100): 9 (69)

[a]Values are expressed as No. (%).
[b]$P < 0.05$.

Table 5. Delayed, Non- and Mal- Union Rates[a]

Type	Delayed Union		Non Union		Mal-Union	
Upper Limb						
Clavicle	1/20 (5)	1 MS N/O	0/20 (0)		4/20 (20)	2 MS N/O, 2 Lat N/O
Metacarpal	0/27 (0)		1/27 (4)	1 O - MUA and KW	4/27 (15)	2 N/O, 2 O - MUA and KW
Distal Radius	0/73 (0)		0/73 (0)		1/73 (1)	1 N/O Cast
Scaphoid	4/24 (17)	4 N/O: All had ORIF	2/24 (13)	2 N/O: No further Sx	0/24 (0)	
Lower Limb						
Ankle	0/49 (0)		0/49 (0)		0/49 (0)	
Tibial Diaphysis	0/18 (0)		0/18 (0)		0/18 (0)	

Abbreviations: Cast, Cast Management; Lat, Lateral; MS, Mid Shaft; MUA and KW, Manipulation under Anaesthetic and K-Wire; N/O, Non-Operative; O, Operative; ORIF, Open Reduction Internal Fixation; Sx, Surgery.
[a]Values are expressed as No. (%).

fractures cohorts is required to fully determine the effects of varying management strategies on sporting outcome.

Assessing the site-specific cohorts from this study, for ankle fractures, those managed operatively took twice as long to return to soccer as those managed non-operatively. Similarly those managed operatively had nearly three times the rate of persisting symptoms. Reviewing the treatment strategies within the sub-groups of AO Classifications, we found variations in management for 44A.2, 44B.1, 44B.2 and 44C.1 fractures, with fracture displacement directing the need for surgical intervention. Operative management significantly increased the duration of return to soccer for 44B.1 and 44C.1 fractures but not for 44A.2 and 44B.2 fractures. It would appear that similar ankle fracture patterns are currently managed both operatively and non-operatively, with operative management resulting in significantly prolonged duration to return to soccer. This is keeping with the study by Robertson et al. (5), who also found that for similar ankle fracture types, surgical management resulted in higher return times to sport over conservative management. The decision for surgical management in that study was directed by the presence of fracture displacement (5). Thus, it was recommended that all undisplaced fractures could be attempted for conservative management, given the benefits noted (5). Similarly, we would recommend non-operative management for all undisplaced ankle fractures, with operative management reserved for displaced fractures.

For tibial diaphyseal fractures, those managed operatively returned earlier to soccer; however they were noted to have a higher rate of persisting symptoms. This is in keeping with the results from a recent systemtic review by Robertson and Wood (10), who similarly found that operatively managed tibial diaphyseal fractures returned to sport sooner. This was felt due to the fact that the operative cohort could mobilise earlier, allowing for preservation of muscle mass, avoidance of joint stiffness and early return to rehabilitation (10). Assessing the time to return to soc-

cer by AO Classification, simple oblique fractures took less time to return than simple transverse or bending wedge fractures. Variation in management of simple oblique and simple transverse fractures was present, with fracture displacement indicating the need for operative management. It would appear that operative management of tibial diaphyseal fractures reduces time to return to soccer, though increases the rate of persisting post-operative symptoms. While fracture displacement guides the choice for surgical management, it would appear that undisplaced fractures may benefit from operative management, as noted by Robertson and Wood (10). This, however, is at the risk of surgical complications and so, any such treatment decisions need to be discussed extensively with the patient (10). We would advocate consideration of operative management in young fit individuals who aim to return to sport as soon as possible though appreciate that such decisions should be directed by clinical context, fracture configuration, clinician experience and patient preference.

For scaphoid fractures, those of the waist or proximal region managed operatively with acute percutaneous screw fixation demonstrated the quickest return to sport at a mean return time of 8.5 weeks compared to 12.7 weeks with cast management Those with delayed union and subsequent surgical fixation demonstrated significantly prolonged return times with a mean of 40 weeks. Comparing the AO sub-classifications, there existed variation in the management of waist (24 C2.2) and proximal (24 C2.2) fractures, owing to the possibility of acute percuateous screw fixation for such fractures. Our results are in keeping with those from McQueen et al. (13) who found that acute percutaneous screw fixation of undisplaced scaphoid waist and proximal fractures resulted in improved return times to sport over cast management (6.4 weeks vs. 15.5 weeks). As such, we would recommend consideration of such a technique in the athlete to aid a quicker return to sport. However, in such cases, given that conservative management is an equally acceptable alternative, the patient must be fully counselled on the risk and benefits of both forms of management before treatment decisions are finalised.

For clavicle fractures, the return to soccer times showed variation based on the configuration and location of the fracture and the mode of treatment. Undisplaced fractures showed good results with conservative management, with a mean return time of 13.8 weeks. Similar findings were noted in a recent systematic review by Robertson and Wood (11), who performed a meta-analysis of all the available studies reporting return to sport following clavicle fracture; as such we recommend conservative management for all undisplaced clavicle fractures. Displaced lateral fractures showed a prolonged return to sport with surgical management, but given the risk of non-union with conservative management, this is the required treatment for such injuries (11). Further research into the optimal surgical modality for such injuries should be promoted to optimise return times (11). For displaced mid shaft fractures, surgical management was found to result in a reduced time to sport compared to conservative management. This is keeping with the results from Robertson and Wood (11) who found that, on meta-analysis of the available studies, conservative management of mid-shaft fractures resulted in a mean time to return of 21.5 weeks, while operative management resulted in a mean time to return of 9.4 weeks. As such there is a growing trend for the consideration of surgical management of such injuries, particularly in the high level athlete, as this can offer improvement both in return times to sport as well as resultant function (11). However all such patients much be counselled of the surgical risks before embarking on such treatment, given that conservative treatment remains a suitable option (11).

For metacarpal fractures, those managed operatively took four times longer to return to soccer with nearly twice the rate of persisting symptoms. Comparing the AO Classification sub-groups, variation in management existed for 25 A1 and 25 B2 fractures, with fracture displacement directing the requirement for surgical intervention. Management of such fractures is dictated by fracture severity and displacement, and in certain cases surgical management is required to provide fracture reduction and stability. To note we found that those treated with ORIF return quicker than those treated with MUA and K-Wire (12 weeks vs. 21.5 weeks). Similar results were reported by Rettig et al. (25) who found conservative management resulted in a mean return time of 12 days, internal fixation 14 days and MUA and K-Wiring 36 days. As such, we recommend to employ conservative management where possible, but if surgical management is required, this should preferably be performed with internal fixation.

For distal radial fractures, those managed operatively took twice as long to return to soccer with nearly three times the rate of persisting symptoms. Comparing by AO Classification, variation in management existed for fracture types 22A.3, 23C.1, and 23C.3, with fracture displacement directing the requirement for surgical management. Comminuted fractures were noted to be associated with a prolonged return to soccer. It is difficult to draw firm conclusions from this data given the limited cohorts within each AO classification. Fracture displacement and severity serve as the key indicators for surgical management; thus in certain fracture types surgery is required, and patients should be advised that return to sport will be prolonged following. What was interesting to note, was that patients treated with delayed surgery, for undisplaced, radiologically unstable fractures, which later displaced dur-

ing follow-up, had prolonged return times compared to those managed with immediate surgery. This is in keeping with a growing trend to consider immediate surgical fixation of all undisplaced, radiologically unstable fractures in high level athletes, in order to prevent prolonged rehabilitation and return to sport (26). However in such cases, initial conservative management remains a possible option, and as such, the management plan should be thoroughly discussed with the patient, before treatment decisions are made. Regarding surgical techniques, we noted a reduced return rate (33% vs. 100%) and prolonged return time (24 weeks vs. 10.7 weeks) for non-bridging external fixation compared to locked volar plating (ORIF); as such, when surgical intervention is required, we would recommend internal fixation of such fractures in the athletic patient (26).

There were a number of limitations from this study.

The first limitation relates to the cohort selection of the patients. This study was designed from a one year observational register of all adult fractures sustained during soccer in our region. This provided a uniform cohort, from which the return rates and return times to soccer could be recorded and analyzed. Fractures sustained during other sports were specifically excluded, as this would have provided a heterogeneous sporting outcome, reducing the accuracy of the data. No other exclusion criteria were enforced. While inclusion of all sport-related fractures could have provided a more comprehensive assessment of sporting outcome, the inclusion criteria provided a homogeneous end-point, allowing more accurate comparisons to be made.

The second limitation relates to the study design: the observational process of the study only enabled retrospective descriptive data on the treatment outcomes to be obtained. While prospective, randomised outcome data would have preferable, this unfortunately is a consequence of the study methods. We encourage future studies to perform prospective stratification of treatment, along with prospective recording of outcome. Nevertheless, with significant limitations of such data in the present literature, the current data serves to provide a useful description of the outcomes of the current treatment available.

The third limitation relates to the wide variety of fracture locations and patterns contained within the study. This again reflects the observational design of the study, recording all adult soccer-related fractures in a set population over a year period. However, to improve the accuracy of the treatment comparisons, the fractures have been group by fracture location and AO classification. This provides comparative data for fractures at similar locations and of similar configuration.

The final limitation relates to the allocation of treatment for the fractures. Again, secondary to the observational design of the study, set within standard orthopaedic practice, the allocation of treatment for each fracture was based on the recommended orthopaedic methods as specified by Court-Brown et al. (8). Given such circumstances, the choice of treatment will be influenced by fracture severity, with the more severe fracture types more often requiring surgical intervention. This will likely adversely influence the outcome of the surgically-managed fractures. However, as specified above, the outcome comparisons for surgical versus non-surgical treatment were stratified by AO Classification, allowing direct comparison between similar fracture patterns with differing management strategies.

5.1. Conclusion

The management of fractures within athletic populations remains varied despite significant implications on return times to sport and persisting symptoms post-treatment. The role of operative management in the treatment of soccer-related fractures is specific to the location and nature of the fracture. The effect of operative management on return times to sport is fracture specific, though invariably this is associated with higher rates of persisting symptoms. The decision regarding the choice of non-operative versus operative management requires clinical judgment on an individual basis, based on the fracture location and configuration. Experienced clinical judgement with consideration of individual patient characteristics remain important factors in planning management and combined discussion of cases at regular trauma meetings will likely provide the best mode of decision.

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Footnotes

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