



Return to competition following clavicle fractures in professional road cyclists

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ABSTRACT

Objectives: Clavicle fractures are common injuries sustained by cyclists, but there is little evidence about return to competition times (RTCT) in elite cyclists. Our aim was to investigate this, and risk factors for delayed return. **Method:** We identified elite cyclists who sustained clavicle fractures between 2015 and 2020. Freely available records were reviewed to validate data for RTCT. Secondary outcomes included return to outdoor cycling, management, time to surgery, cause of injury, other injuries, and ability to complete the event returned to. **Results:** Records were reviewed of 1449 cyclists, identifying 188 clavicle fractures. 44 were recurrent fractures and were excluded. Those with isolated clavicle fractures (111; 92 male, 19 female) had a mean RTCT of 56.7 days, compared with 74.9 for those with multiple injuries (33) ($p = 0.048$). Those with multiple injuries were excluded from secondary outcome measures. All those with isolated injuries returned to elite competition. 83% were managed surgically with an RTCT of 53.8d, with no significant difference to those managed non-operatively, 59.3d ($p = 0.61$). RTCT was significantly lower for injuries sustained January–July (46.5d) than August–December (95.8d, $p = 0.00$). The incidence during Grand Tours was 0.06/1000 h for males (95% C.I 0.03–0.09), and 0.11/1000h (95% C.I 0.00–0.26) for females. **Conclusion:** This is the largest study evaluating return to sport in elite cyclists with clavicle fractures. Athletes with isolated clavicle fractures, able to return the same season, took an average 46.5 days to return to competition. Elite cyclists are at high risk of clavicle fractures and the majority are managed surgically. RTCT is longer than often expected by the media, and this data can help plan rehabilitation, and manage expectations in both professional and amateur cyclists. **Level of Evidence:** Level V.

1. Introduction

1.1 Clavicle fractures are common in sport, accounting for up to 10% of all sport related fractures.¹ They are particularly common in contact sports and cycling. Clavicle fractures are one of the most common injuries amongst cyclists, including professionals² and amateurs,³ with up to 26% of traumatic injuries being clavicle fractures.⁴ Despite the prevalence of these injuries, little is known about the management of these injuries and the return to sport times for these athletes.

1.2 A systematic review found a high return to sport rate following clavicle fracture, with the mean return to sport time of 96 days.¹ This covered many sports, however studies investigating return to sport in National Football League⁵ and National Hockey League⁷ athletes found mean return times of 245, 211 and 70 days respectively. A study looking

at Tour de France cycling injuries, found 21 clavicle fractures with a mean return to competition time of 49 days.² A case series by Van der Ven et al. reviewed 10 professional cyclists and 15 amateur cyclists and found all returned to competition.⁸

1.3 We aimed to investigate the prevalence of clavicle fractures amongst professional cyclists, and the rate and time to return to elite level competition. We also aimed to identify any risk factors for a delayed return.

2. Methods

2.1 An online database (www.procyclingstats.com) was used to identify the start list for the Tour de France, the Giro d'Italia, and the Vuelta a Espana, also known as the three 'Grand Tours,' for male cyclists,

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and La Course by Le Tour de France, the Giro d'Italia Internazionale Femminile and the Madrid Challenge by la Vuelta for female cyclists. All cyclists from these start lists for the years 2015–2019 were then reviewed on the database for collarbone injuries between January 2015 and June 2020. The cyclists' age, date of injury, date of return to competition, other injuries and ability to complete the competition returned to were recorded from the online database. Publicly available online records, press releases and social media profiles including Twitter, Instagram and Strava were used to confirm accuracy of the data from www.procyclingstats.com. Where available, data was also collected on whether the injury was sustained in training or a race, mechanism of injury, operative or non-operative management, date of surgery, other injuries, side of injury, radiographs online, recurrent injuries, and the date they returned to outdoor training. If insufficient details were found online to confirm the accuracy of the data, the cyclist was excluded. Any cyclists with a reported previous clavicle fracture on the same side was excluded.

2.2 Time to return to competition was calculated in days from the date of injury to the date of the next professional cycling competition they started. Time to return to cycling was calculated from the date of injury to the date the cyclist first reported they were cycling outside on their social media profiles.

2.3 We calculated the incidence of clavicle fractures in terms of rates per 1000 h, as this is a common way of expressing rates of injury in sports and allows comparison between different sports⁹ and is also recommended by Heron et al. for reporting cycling injuries.¹⁰ To do this we calculated the total number of primary clavicle fractures during the three Grand Tours and the comparative female events from 2015 to 2019, and divided by the total hours of cycling by all cyclists in those events.

2.4 Statistical analysis was performed in Microsoft Excel with t-tests performed to identify a statistically significant difference between subgroups. A *P* Value of <0.05 was used to define significance in comparison between groups.

3. Results

3.1 We identified 1449 cyclists, 845 were male, and 604 female. 188 sustained a clavicle fracture between 2015 and 2020. This included 144 primary clavicle fractures (120 male, 24 female), and 44 recurrent fractures, which were excluded. 33 Cyclists sustained simultaneous injuries and were excluded from the primary outcome analysis and analysed as a separate secondary outcome. The mean age to sustain a clavicle fracture was 28 for men and 27 for women. 124 occurred in a race and 20 in training.

3.2 In 111 isolated fractures, all returned to professional cycling. 31/33 (94%) of cyclists with multiple injuries returned to elite competition, with the one cyclist reported to be retiring due to another injury sustained in the same incident.

The mean return to competition time for isolated clavicle fractures was 56.7 days (s.d 36.7d), (55.9d male, 60.8d female *p* = 0.65) the range was 14–199 days. As there was no significant difference between male and female cyclists, further analysis was done on the whole group.

3.3 It was possible to identify the management from online records for 92 cyclists of cyclists with isolated clavicle fractures, with 83% treated surgically. When surgery was performed this was done at a mean of 2.7 days post injury. The RTCT for those treated surgically was 53.8 days, and 59.3 days for those managed non operatively (*p* = 0.60).

3.4 It was possible to identify the mechanism of injury in 123 cyclists (Table 1).

3.5 Cyclists with multiple injuries took significantly longer to return (74.9 days, s.d. 46.5, *p* = 0.048) and the associated injuries are shown in Table 2.

3.6 We were able to calculate the return to outdoor cycling time in 65 cyclists with isolated fractures, with a mean time of 22.8 days. There was no difference in return to outdoor cycling time between those managed

Table 1
Mechanism of injury.

Mechanism	Number of Cyclists
Crash involving other cyclists	57
Fall	44
Collision involving motor vehicle	9
Collision with street furniture	7
Collision with spectator	3
Collision with animal	2
Blown off bicycle by helicopter	1

Table 2
Associated injuries sustained at time of clavicle fracture.

Associated Injury	Number of Cyclists
Rib fractures	15
Concussion/Head Injury	10
Scapula Fractures	6
Pelvic Fractures	3
Spinal Fractures	2
Pneumothorax/Haemothorax	5
Lacerations	2
Other	3

operatively (23.0 days) vs those managed non-operatively (22.8 days, *p* = 0.96).

87.4% of cyclists were able to complete the event they returned to.

3.7 If the fracture was sustained towards the end of the usual road cycling race season (August–December) they were less likely to be able to return to racing that season, and so took significantly longer to return to competition (95.8 days) than those who were injured earlier in the season (January–July) (46.5days, *p* = 0.00). The same difference was not seen in return to outdoor cycling time, (21.5 days early season, 27.8days late season, *p* = 0.16), suggesting that the difference in returning to competition was due to the dates of the competitions.

3.8 The mean return time in cyclists with isolated clavicle fractures injured when return that same season was possible, was 46.5 days (88 cyclists, s.d. 19.6days).

3.9 The total time of cycling of the three grand tours from 2015 to 2019 was 225,273 h, with 14 cyclists sustaining primary clavicle fractures in these events, giving an incidence of 0.06 fractures per 1000 h (95% c.i. 0.03–0.09).

The total time for the female events was 18,490 h, with 2 primary clavicle fractures during these events, and an incidence of 0.10 per 1000 h (95% c.i. 0.00–0.258).

4. Discussion

4.1. Prevalence

Of the 1449 road cyclists reviewed, 144 sustained a primary fracture to the clavicle during the time period (9.9%). 6 fractured both clavicles during the period. The prevalence was higher in men (120/845, 14.2%), than women cyclists (24/604, 4.0%). This is a high proportion, and it is well recognised that clavicle fractures are common in professional road cyclists. This is a similar rate to that seen in cyclists in Brazil,³ where an overall prevalence of 13.5% was found amongst a selection of professional and amateur cyclists, with a positive association between time cycling and clavicle fractures. Clavicle fractures were found to be the most common cause of retirement from the Tour de France.² Barrios et al. compared 2 groups of professional cyclists from 1983 to 1995 and 2000 to 2009 found 13.8% and 19.7% of the cyclists had clavicle fractures during the respective time periods.⁴

Although the prevalence was high, when we looked at the rate per 1000 h of activity, we found a rate of 0.06 per 1000 h for the male cyclists, and 0.10 for female cyclists. While this is the recommended way of

reporting incidence of cycling injuries,¹⁰ few studies report it this way. We were not able to calculate the injury rate per 1000 h of training as is also recommended, as these records were not publicly available. According to a systematic review by Rooney et al.,¹¹ there was a wide variation in the reported rate of injury in cyclists from 3.23 per 1000 cyclists to 116 per 1000 cyclists. One study which reports per 1000 h found an overall injury rate of 2.8 per 1000 h in the Tour of Turkey, but did not include any clavicle fractures.¹²

4.2 It was possible to identify the cause of the injury in 123 of the cyclists, with a crash with other cyclists the most common. This is similar to the findings of DeCock¹³ who looked at injuries sustained by cyclists in organised races in Flanders, with 51% involving other cyclists and 16% following a fall. Our study found a higher rate of collisions involving motor vehicles at 8% compared to 0.6% in DeCock's study, which is likely to be because the races in their study were non-professional and so would likely have fewer vehicles on the course.

4.2. Return to competition

A systematic review of return to sport in clavicle fractures by Robertson et al.,¹ found 92% of patients were able to return to sport, with an average return to sport time of 96 days. This covered multiple sports including cycling, but did not differentiate between the various sports in return times. Only one cyclist in our study was unable to return to elite level competition, and this cyclist also sustained a vertebral fracture in the same incident, which was stated as the reason for retirement in the press release.

Other sport specific studies including ice hockey⁷ found a mean RTCT of 70 days, and studies of American Footballers found a mean return of 211 days in surgically managed injuries⁵ and 245 days in non-operative management.⁶ Our study found a shorter RTCT for cyclists than these other sports, with an overall mean of 56.7 days for isolated clavicle fractures. This was reduced to 46.5 days when earlier in the season.

We suggest this reduced time to return to competition in cyclists is due cycling being non-contact, so if the cyclist doesn't fall, there is a low chance of a high force going through the clavicle. Cyclists can also return to indoor cycling very soon, as they can do so without having to put much force through the injured clavicle, allowing them to maintain fitness levels during the fracture healing period.

This is in keeping with the results from the case series by Van der Ven,⁸ who reviewed 10 professional and 15 amateur cyclists with displaced clavicle fractures managed with a locking plate. They allowed professional cyclists on the indoor trainer on day 2 post operatively, and outside training the following week. They state that average return to outdoor cycling was 10 days in the professional group, and 2–6 weeks in the recreational group.

4.4 We did not find a significant difference in RTCT for those managed operatively or non-operatively. We were not able to determine the fracture pattern in all the cyclists, but where radiographs were available online, or descriptions of the fracture were given by team doctors, it was mostly undisplaced fractures that were treated non-operatively. Displaced midshaft fractures were usually managed with an open reduction and internal fixation (ORIF), while displaced lateral clavicle fracture were usually treated with ORIF or Coracoclavicular ligament reconstruction. We believe that the different management plans are based on the type of fracture and would not draw conclusions on the recommended management of different fracture patterns based on our study.

The study of injuries in the Tour de France² found that those having surgery returned significantly quicker (37.6 days vs 75.5), although they did not differentiate between different types of fracture, and concluded that further analysis was required to understand which fractures benefit from operative management. While a systematic review has shown shorter return to sport times in those treated operatively,¹ this study provides evidence that appropriately selected patients can return to

cycling in a timely fashion with conservative management.

4.5 Our data showed that those with multiple injuries took longer to return to competition, which is what we would expect to see, as they would likely need more time away from training to recover from the other injuries. This was also seen in the time to return to outdoor cycling with those with isolated injuries returning in 23 days on average, compared to 36 days in multiply injured cyclists.

4.3. Timing of injury

The cyclists injured in August to December took significantly longer to return to competition compared to those injured between January and July. The Union Cycliste International (UCI) road racing season typically runs from the end of January until early October,¹⁰ and so cyclists injured toward the end of season would have to remain out of competition longer if they could not return by the end of the season, even if they were fit to return earlier. The return to outdoor cycling time was 21.5 days for those injured in January to July, and 27.8 days in those injured from August to December ($p = 0.16$). This again supports that it is possible that those injured later in the season were ready to return earlier, but had to wait for an event to return to.

Return to competition for professional athletes is a complex decision, and will vary dependent on the specific athlete, the type of sport and the particular injury. It must take into consideration the short-term risks of re-injury, or poor performance, along with the long-term consequences of these. There may be pressures to return to a particular event, and also consideration of the impact on the performance of a team. It is important that these decisions involve the athlete, medical professionals and coaches in a shared decision-making process.¹⁴

4.7 To our knowledge this is the largest study of clavicle fractures in elite cyclists. We recognise there are a number of limitations of our study. All the data was from publicly available records, without access to medical records and so may be subject to reporting bias. This is a recognised method and has been used in other studies.^{5–7}

While 20% of the cyclists shared radiographs online, it was not possible to determine the fracture pattern or severity in the majority of cases. It was also not possible to determine the exact management in terms of operative technique or post-operative rehabilitation regimes.

The time to return to competition may be affected by cyclists returning to competition before they are truly ready, or having to wait until a particular race or the start of the next season. We have attempted to allow for this by performing subgroup analysis of those for who it was possible to return in the same season, and feel this gives a more accurate prediction of the average return time.

4.8 This was also the first study to investigate return to outdoor cycling rather than just return to competition. Again, this relied on information from social media or Strava profiles, which cyclists may not have included all their rides on. We feel this data also helps cyclists to have an idea of when they may be able to return to cycling for leisure, without having the necessary fitness to compete in races.

4.9 We excluded any recurrent clavicle fractures, but it is an area that requires further investigation into the rates and risk factors for recurrence. Our study also only focused on road cyclists, and further work needs to be done to assess the return to competition in other variations of the sport.

5. Conclusion

5.0 Clavicle fractures are a common injury amongst elite road cyclists, but have a very high return to competition rate. While the overall mean RTCT was 56.7 days for isolated clavicle fractures, those who were able to return the same season, took an average of 46.5 days. This is a shorter recovery period than seen in other sports. Associated injuries and being injured later in the season were risk factors for a delayed return. We believe this data will allow for planning rehabilitation in both professional and amateur road cyclists, as well as managing

expectations in these athletes.

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Ethical committee

Approval was not sought for this study as all data was from publicly available records.

Authors contribution

Alastair Konarski: Conceptualisation, Methodology, Data Curation, Formal analysis, Investigation, Project Administration, Validation, Visualisation, Writing – original draft.

Matthew Walmsley: Data Curation, Formal Analysis, Investigation, Validation, Visualisation, Writing – original draft.

Neil Jain: Conceptualisation, Supervision, Writing – review & editing.

Author statement

All authors contributed to the concept, design, analysis and writing the paper. Data collection was performed by AK and MW.

Declaration of competing interest

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