INTRODUCTION

Anterior cruciate ligament (ACL) injury in football players carries a high burden for the player, club, and medical team. The mechanisms underlying ACL injury are multifaceted and complex. Despite their unpredictable nature, identification and subsequent reduction of modifiable risk factors is of paramount importance.

High traction between a player’s football boot and the playing surface is thought to increase risk of anterior cruciate ligament (re)injury. “My studs got caught on the playing surface while my body kept rotating” is a common phrase used by players to describe the mechanism of injury in a non-contact situation (Figure 1). However, high quality evidence for this premise is limited to American football only with no prospective studies in soccer football or Australian rules football to date.

Football boot selection is one of the few immediately modifiable factors that a player can influence just before kick-off when the surface properties and climate are largely pre-defined. Surprisingly, there are no prospective studies which link shoe-surface traction and injury to date in soccer; thus, many questions remain.

Surgical reconstruction of the ACL is still (at present) the treatment option most elite football players choose when their goal is to return to the same level of sport. However, obvious questions exist with pertinent considerations about shoe-surface interaction during the return to sport continuum. As usual it’s complex and the context matters, but some examples include:

1. What should a player put on their feet for the first field-based rehabilitation sessions after ACL reconstruction (ACLR) in football?
2. Is it best to use running shoes first or go straight into football boots from the outset?
3. Are there any playing surface considerations at the different stages of the rehabilitation, return to train, return to sport continuum?
4. Should the same advice be given for male and female elite players?

MIND THE GAP

Evidence-based practice is said to optimise the decision-making process in sports medicine and science. Yet, in this case, there is a clear lack of empirical evidence to support how the players feel about the mechanism of injury and what has been published to date in scientific journals.

Even if/when good applied research is produced there are issues with translation of the findings into real-world elite sport settings. Our research showed that shoe-surface rotational traction varies with different football shoe outsoles (studs, blades etc), grass types, and climatic conditions. Metrics on this paper show it was widely accessed and discussed. However, it is still unclear if this type of research is applied enough to translate into what happens every day at pitch-side practice?

We were interested to find out so what follows is an insightful discussion on ACL injury and shoe-surface interaction with some top practitioners in elite soccer, Australian rules and American football (NFL). We asked each expert three questions about shoe-surface interaction and the journey back to football after ACLR. In addition, we have separated responses from those involved with male and female sports respectively to determine if there are any apparent differences / considerations.
AN INTRODUCTION TO OUR EXPERTS

Daniel Bonanno podiatrist (B.Podiatry, PhD) is the consultant podiatrist to the Carlton Football Club (AFL) and Melbourne City Football Club (A-League). He is also a Senior Lecturer in the Discipline of Podiatry at La Trobe University. @DanielRBonanno

David Rennie physiotherapist Leicester City football club recently completed his PhD investigating “whether the natural turf pitch can affect injury and performance within elite football”. He has been Head Physiotherapist at Leicester City Football Club since 1999, during which time he has contributed to the team success in winning the League Cup, as well as League 1, the Championship and the Premier League. @rennie_physio

Philipp Jacobsen physiotherapist is Medical Rehabilitation & Performance Manager at Liverpool football club. He has previously worked as physiotherapist for the Qatar national football team, Panathinaikos FC, and Portsmouth FC. @helasphil

Matt Konopinski, Physiotherapist The Football association is rehabilitation specialist physiotherapist at the English football association. Former head physio Liverpool football club. @Matt_Kono

NFL practitioner chose to stay anonymous is working in franchise that won the NFL championships several times in the last 20 years.

Brooke Patterson, physiotherapist, PhD Candidate, La Trobe University is currently investigating the impact of anterior cruciate ligament injury on the lives of young adults, particularly the risk of osteoarthritis at a young age. Brooke played for Melbourne FC in the first 3 seasons of the Australian rules football league for women (AFLW) and has sustained an ACL injury herself. Brooke is involved in current AFL projects, aimed at monitoring and reducing injuries, and improving coach education. @Knee_Howells

Kate Beerworth, physiotherapist for Australian Women’s National Football Team Physio (Matildas) 10 years (2007-2016) has worked in football since 2004 starting with FFA as physio for U20 Women’s National team and since 2016 as National ACL prevention & injury prevention co-ordinator in a consulting role. In May 2019, Kate started working with Cricket Australia as the Australian Women’s Team Physio. @KBeerworth

Sam Blanchard physiotherapist has worked elite men and women at Brighton & Hove Albion, Buffalo Sabres in NHL, Scottish rugby union, and Arsenal FC. Sam is currently working at Manchester City FC with the academy. @SJPhysio_sport

RESPONSES FROM MEN’S FOOTBALL CODES

Question 1: After Anterior cruciate ligament reconstruction, what does a usual pathway look like for progression back to ‘on-field’ rehabilitation in football boots?

DR – It goes by feel. The player must be physically and psychologically ready to return to ‘on-field’ rehabilitation. Players will pass agility or change of direction tests in trainers on an indoor surface before progression to ‘on-field’ rehabilitation session in boots. The first pitch session in football boots is somewhat of a regression. Velocity is taken down a notch along with complexity of movement tasks. Speed of movement is a major issue for re-injury risk so there is a graduated progression there.

PJ – ACL injuries are relatively rare in elite male football. Players generally start running on the pitch in their trainers (running shoes). Things like 2 x 10min runs predominantly linear and then some longer runs to get the volume in. Boots are used for change of direction type movements, but we recommend the players go by ‘feel’. They can try different football boots to perform some movements at low speed to see which shoes feel like they provide the correct amount of traction for the surface (and climate) on the day (see Figure 2)10. Often the same make

Figure 1: Non-contact mechanism of ACL injury with “foot fixation” where studs get trapped in playing surface.
and model of football boot will come with several different outsole options suited to firm ground or soft ground for example (See Figure 3).

**MK** – This is a real ‘landmark’ moment for any player after long-term injury. Putting their boots on again to run on the pitch seems to do plenty of psychological good. The first ‘on-field’ session tends to be linear so no real issues with using football boots for this. Generally, we are happy with the strength or levels of graft healing before heading outside again.

**NFL** – Important to respect the healing time required and individual variability among athletes. Players must earn the right to get to the next stage of rehabilitation. In our set-up they must back-up reaching certain criteria again and again rather than hitting a number for a one-off test.

Players will have run on the AlterG treadmill and then also completed various movement and running tasks before the first pitch session. We use running shoes first but for sure look to get them back into cleats at the earliest opportunity.

**Question 2: Do players ask about optimal footwear choices on their return to field-based training?**

**DB** – Some do. Any conversation with the player must be nuanced when encouraging a shift to boots with smaller round studs which will have lower rotational traction. The last thing you want to do is add fear to footwear selection, especially if the player is contracted to a specific brand and model of shoe.

Recently, a young professional AFL player (with no history of knee injury) came to ask what he could do to ensure his boots were correct for him. His aim was to minimise risk of injury while still having adequate shoe-surface traction to compete at the highest level.

AFL players are more used to being advised on what to do in terms of footwear selection, whereas soccer football players in the A-league often have strong preconceived ideas about what they want from their footwear, often with the goal of maximising ball touch, so boot changes can be more difficult to influence.

AFL Clubs must supply a minimum of 3 pairs of boots, and 2 pairs runners, to all players (players can also elect to have alternative sponsor). If a player has a medical reason for not wearing the club sponsored footwear, then they are supplied footwear from an alternative brand (as recommended by the club medical team, including the podiatrist). Lack of choice in terms of boot width is a huge issue for us in AFL.

In AFL there is also a podiatrist at every team in the league.

**DR** – Not often. Players tend to use boots from the very first pitch session as they have already passed complex movement tasks inside with shoe and surface combinations that can have relatively high friction coefficients. This means it’s not a huge step-up, in terms of shoe-surface traction, once they lace-up their boots and head out on the pitch for the first time. Players don’t often ask about boots but do enquire about the surface and how that might affect their fatigue levels.

**PJ** – Most players have boot sponsorship agreements so they will wear what is provided for them without giving it much thought. However, some do like to give input into what type of outsole the shoe will have. For example, one senior player gets Nike to add an outsole from a few seasons ago that consists of mostly round moulded studs on the outsole rather than use new blade or cleat versions of the shoe.

**MK** – It doesn’t come up often. We try to steer players away from lace-less or super flexible boots for this stage of rehab. Most players choose boots on ‘feel’ and appearance of the

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**Figure 2**: Football specific functional traction course adapted from Sterzing et al\(^{10}\).
Design style really seems to matter to most players rather than any inherent biomechanical parameters the shoe may have.

NFL – Most players I have been involved with in American football do ask for footwear advice. However, very few blame the shoe itself. More often they will question the playing surface rather than the shoe.

Question 3: Any concerns about playing surface conditions and risk of (re)injury?

DB – We try to have players ready for shifts in surfaces by having multiple outsole types. For example, they may train on artificial grass in an AG outsole shoe and then play on natural grass or hybrid reinforced grass in a firm ground outsole shoe. This was directly informed by research conducted at Aspetar® so for that we say thanks!

DR – We did have an issue once where two players sustained an ACL injury during a shift to a sub-standard artificial grass surface that had high shoe-surface traction. Both players were wearing the same boots. Combination of a high friction surface and high traction shoe seems to have been at least partly implicated in the mechanism of injury here.

Depends on the style of football they must eventually return to. For our club we are looking to use a firm surface that returns more energy and possibly decreases fatigue for a given movement like sprinting. Therefore, the player must get accustomed to moving on a surface with particular mechanical properties again. We have the benefit of great ground-staff that can set-up the training surfaces in a graduated manner (increasing levels of surface hardness for example). This allows us to provide the players with a surface which mitigates the risk to the healing tissue but one which also enables performance in the most efficient way.

PJ – If the pitch is too soft (or too hard) it might increase player fatigue. Our excellent grounds staff work to keep the surfaces...
within a certain window for properties like surface hardness. We also teamed up with an independent company to come in and test our pitches and provide objective data that can help inform footwear selection.

MK – Players are generally concerned about artificial grass or some of the playing surfaces on pre-season tours. I have been very fortunate at both Liverpool and the English FA to have fantastic playing surfaces.

NFL – Our players train on natural grass but compete on everything from artificial grass, hybrid reinforced grass, to fully natural grass match day playing surfaces. The players prefer (love) the natural grass training surface our excellent grounds staff prepare for them.

RESPONSES FROM WOMAN’S FOOTBALL CODES

Question 1: After Anterior cruciate ligament reconstruction, what does a usual pathway look like for progression back to ‘on-field’ rehabilitation in football boots?

BP – Players are usually encouraged to return to their boots as soon as possible for on-field rehab, which may include running or modified skills. Use of trainers is limited when they return to the pitch but may be used for volume running at the end of on-field rehab session. Psychologically, players like getting into their boots where possible, as they feel like they are a part of training, and the idea is that feet should be conditioned to tolerate training in football shoes again early in the rehabilitation and RTS continuum.

A podiatrist comes to the club to give broad footwear recommendations, and one-to-one appointments are up to the individual. However, shoes made with a female-specific last are hard to come by. Two footwear companies are developing a female specific shoe for the female football players. This is super exciting, and players have been involved by providing feedback on comfort, fit and performance on existing and new models. The volume around the upper at the forefront of the boot reflects the shape of a female feet rather than using a men’s B-width fitting (common in footwear manufacturing). Comfort is queen! - unless they are comfortable, they are going to change their movement patterns, which has implications for injury.

KB – Before players return to the pitch, they have generally completed movement tests in training shoes in gym. Complexity and chaos are gradually progressed so that the shift outside seems less of a jump.

Players tend to start in running shoes with linear tasks for the first on-pitch session. A large reason for this also is to control the variables and avoids introducing running on pitch and a change of shoes at the same time. If the knee doesn’t tolerate the running load, sticking to the same shoe can help decide whether it’s an impact related issue, training load issue or change of footwear. Then move into boots as change of direction and football specific drills are progressed.

SB – Firstly, it’s important to mention that each individual situation is managed according to various contextual factors.

Initially, an “ideal-world” scenario for a 9-month rehabilitation plan is mapped out with an emphasis on the fluid nature of this (e.g. timeframes change as criteria are met etc).

Running is often delayed until 16-18 weeks. Easier transition to running at this stage after working on running or movement drills. Return to running at 16-18 weeks is just my approach, not necessarily what should be done. Some people will comfortably run at 10 weeks... but when they probably have 6 months of running ahead of them, I just think “what’s the rush” and find it a smoother transition to work on running type drills up until 16 weeks. We find running can look a little laboured if started early (<12 weeks). Everyone is different though in how this is progressed.

We move players back into boots for linear on-field running at the earliest opportunity. Players are so used to being in boots that it makes sense to use them early. The linear work is combined with some rotational (slightly higher risk) movements in the gym lead by the S & C staff. e.g. lateral bounds

Question 2: Do players ask about optimal footwear choices as they return to field-based training?

BP – Not usually. Some players feel very strongly about a particular football boot brand and/or model being implicated in their ACL injury or re-injury. Ex-players have vented frustration about boots designs, with some believing their careers were cut short due to poor footwear choices.

KB – No not really. Only if a player “blames” the boot or feels it was responsible for the mechanism of injury. For example “felt like my shoe got trapped on the grass and wouldn’t release”. Occasionally players have felt nervous returning to the on-field sessions. At this stage we have a conversation about footwear options.

SB – No not in my experience.

“Players tend to stay in their chosen boot model regardless of injury. They are very closed to changing types of shoes in my experience”.

Question 3: Any concerns about the playing surface conditions and risk of (re) injury?

BP – In pre-season sub-elite female Australian football teams compete with cricket due to the limited number of pitches available. Training can often shift to artificial surfaces or natural grass of wide-ranging quality. Players don’t tend to change their boots for the surface shifts, and are either not aware of different footwear options, or they are not available. Some will wear different shoes for training and matches. For example, a more supportive shoe during training, and a shoe with greater performance benefits (i.e. lighter, more flexible upper) for matches.

KB – W league in Australia deal with surface shifts between artificial and natural grass of varied quality. Often players do not have other shoe (outsole) choices to match to the surface. In some cases, they tend to be driven by cost and will wear shoes that are provided by sponsors for free. A lack of smaller and narrow boot sizes for females can also dictate or limit the options and is a significant issue for the female athlete. Some have to use children’s sizes which means the material quality of the shoe is not adequate. (eg kangaroo leather upper is not common in kids football boots).

SB – Varied quality of playing surfaces in the elite female competition is a concern in the (FA Women’s super league UK). Some clubs are well backed and spend money on the surfaces while other simply don’t have
the money. Add to this that female players often don’t have a kit man to carry different boots around or quite often don’t even bring another boot option to away matches.

CONTEXT AND COMFORT ARE KING/QUEEN.

In the preceding discussions, some key themes were apparent in the responses of our front-line elite sport practitioners across the different football codes and these have been summarised below:

1. There is a large gulf in playing surface quality and football boot choice in elite female soccer and Australian rules football. This likely comes down to money. Add to this that female players due to several risk factors are sustaining an ACL injury than male players. Female specific football boots should be very high priority for footwear manufacturers to develop. Simply using a men’s version with a narrower last will not do. Having comfortable boots that fit female foot anatomy, with several outsole (traction) options is overdue. It is pleasing to see some companies making inroads in this area.

2. There is no exact recipe for what players should wear on their feet during rehabilitation following ACLR. It is pragmatic to suggest shoes with reduced rotational traction when returning form ACLR. How long players should use these shoes or weather they ultimately reduce (re-)injury risk in elite football is yet to be determined. Most practitioners mentioned going by “feel” with the athlete on top of both functional and time-based criteria.

3. Getting back into football boots is a momentous milestone along the return to sport continuum.

4. More must be done to mitigate risk of the foot fixation. This is how the players feel and we should listen. This might include superior maintenance to bring rotational traction down on certain playing surfaces (e.g. verti-cutting lateral root growth in warm season grass species). Likewise, improved individual tailored footwear programs such as having a podiatrist in each club like many have adopted in AFL would appear an intuitive step forward. Tailored footwear programs have proved successful at reducing lower limb injuries in professional rugby league.

In summary, these practitioners chat to players day-in day-out and get to hear their thoughts, hopes and fears. To that end, listening to how a player “feels” about certain playing surface characteristics or football boots may be the best approach at present. Future research will utilise wearable technologies and advances in shifting the testing labs to the field. Until then, subjective comfort and players’ rating of perceived traction after completing a functional traction course is still King/Queen.

Acknowledgement: Author would like to thank Dany Baghdan for taking the photographs for Figure 3.

References

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