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Rehabilitation and successful return to play of a 17-year old elite soccer player with juvenile osteochondritis dissecans trochlear groove lesion of the knee: A case report

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Abstract

This case summarises the rehabilitation and return to play management of a 17-year-old elite male soccer player who required surgical stabilisation of an Osteochondritis Dissecans (OCD) lesion of the trochlea groove. Trochlea groove lesions represent <1% of OCD cases, resulting in limited evidence to inform practice. The case was initially identified as antalgic running gait, and at this point the player revealed progressively worsening knee pain (over preceding 2 months) which presented as patellofemoral pain with a small knee effusion and quadriceps atrophy present on assessment. No improvement in symptoms after two weeks of unloading (no running) and traditional patellofemoral treatment prompted magnetic resonance imaging and computed tomography scans to inform surgical intervention. We present a summary of the four-stage rehabilitation process defined by objective assessments, resulting in a successful return-to-play 24 weeks post-surgery. This case advocates consideration of OCD in the assessment of persistent knee pain in young athletes.

Keywords: Juvenile Osteochondritis Dissecans, youth soccer, trochlea groove

Introduction

The epidemiology of soccer injury in male professional players has been well described, but typically research is focussed on senior professional players negating the direct relevance to this case of a 17-year old male player. Epidemiological research in elite youth soccer has consistently highlighted knee injuries as a primary concern (Price *et al.*, 2004), comprising up to 17% of all injuries (Renshaw & Goodwin, 2016) and

being the joint most commonly affected by Osteochondritis Dissecans (OCD) (Carey & Grimm, 2014; Kocher *et al.*, 2006).

OCD describes the pathological presentation involving delamination with or without sequestration of the subchondral bone from the underlying tissue (Schulz & Chambers, 2013). Proposed risk factors include genetic predisposition, defective skeletal development, vascular insult, repeated trauma and altered joint/cartilage loading mechanics (Schulz & Chambers, 2013; Carey & Grimm, 2014). OCD has been reported most frequently during adolescence (10 - 19 years) and is more prevalent in males (Thompson *et al.*, 2014).

In this case the 17-year old male is an elite soccer player, contracted to a professional club. A diagnosis of Juvenile OCD (Edmonds & Polousky, 2013) identifies this player as skeletally immature with open epiphyseal growth plates confirmed by radiographs. More than 70% of OCD lesions are found in the postero-lateral aspect of the medial femoral condyle (Kocher *et al.*, 2006); the diagnosed trochlear lesion in this case contributes <1% of knee OCD injuries (Juneau *et al.*, 2016).

Discussion

Case Presentation: The player had suffered (but not reported) progressive left sided (non-dominant limb) anterior knee pain for two months. Subjective observation highlighted that the player had developed an antalgic running gait and appeared compromised in acceleration, prompting clinical assessment.

Physical Assessment: The player had a grade one joint effusion and mild crepitus on the lateral facet of the patellofemoral joint, and reduced quadriceps muscle tone and bulk. On the affected limb vastus medialis oblique bulk had decreased from 40.2cm at

baseline pre-season testing to 37.0cm. Single leg counter movement jump height had reduced from a baseline 30cm to 24cm. Sagittal plane running gait analysis (Hudl technique application) identified decreased knee flexion during the loading phase, which presented as a limp. This knee flexion angle was consistent with the point during single leg squat that exacerbated his pain, subsequently hypothesised as the contact point for the patella on the OCD lesion in the trochlea groove.

A prescribed two-week unloading period with a focus on traditional patellofemoral treatment (gluteal strengthening exercises, quadriceps strengthening, neuromuscular control exercises, taping, soft tissue therapy) did not resolve the player's symptoms, and the player was referred for a magnetic resonance imaging (MRI) scan.

Diagnostic Imaging: The MRI scan revealed a cortical fracture of the trochlear groove with intact articular cartilage. The player was referred to an orthopaedic consultant knee specialist, who concluded there was a possible Juvenile OCD lesion in the knee but requested a Computed Tomography (CT) scan to confirm, presented in Figure 1 and reported as:

1. *"... an OCD lesion affecting the lateral femoral trochlea (23x24mm) with a collapsed detached sclerotic wafer of subchondral bone. There is sclerosis and cystic changes seen to the underlying bone of the lateral femoral trochlea.*
2. *The overlying articular cartilage on this non-arthrogram CT appears preserved but best correlated with the MRI scan or a CT arthrogram to assess for potential instability."*

**** Insert Figure 1 near here ****

Treatment:

Surgery: Surgical intervention was recommended to stabilise the OCD lesion. The orthopaedic consultant surgeon performed a lateral arthrotomy; three smart nails were inserted under image intensifier control with good apposition to ensure not to encroach on the player's open growth plates. The surgeon's postoperative guideline was for the player to be braced from 0-30° knee flexion partial weight-bearing for 6 weeks, with a further CT scan at 12 weeks post-surgery to assess healing of the lesion.

Rehabilitative Phase 1- Acute/Unloading Phase (0-6 Weeks): Duration as recommended by the surgeon with objectives to protect the surgical site, retain full knee extension, eliminate effusion, and initiate quadriceps activation (Juneau *et al.*, 2016). A CryoCuff was used to provide cryotherapy and compression to minimise pain and swelling. Static isometric quadriceps contractions performed hourly to assist in reducing swelling and quadriceps activation were supplemented with muscle reconditioning using neuromuscular electro stimulation twice daily to prevent further muscle atrophy. Partial weight bearing gait re-education exercises highlighted that the player adopted his pre-surgery limp, but this was reported as habitual rather than a pain response. At five weeks post-surgery the brace was opened to 0-40° and was increased by 10° per day to facilitate a gradual and progressive increase in knee range of movement (ROM).

Rehabilitative Phase 2- Moderate Loading (7-12 Weeks): Objectives were to return to full normal weight bearing ambulation, increase ROM and begin lower limb hypertrophy development, co-ordination and balance exercises. Manual therapy was used to improve flexion ROM, supplemented with active assisted heel slide exercises,

and isometric loading was introduced in a high squat position (30° flexion) progressing to 90° flexion as symptoms allowed. Cardiovascular reconditioning commenced with static bike work eliciting low intensity aerobic heart rate response at 8 weeks post-surgery with synchronous gains in knee ROM and muscle conditioning. The player also commenced his upper body hypertrophy and maximal strength programme, identified as a supplementary performance gain not associated with the injury.

The player underwent a CT scan during the end of this stage (Figure 2), from which the surgeon concluded that the lesion had healed well, and the player was able to progress his rehabilitation and return to running in 2-3 weeks.

** Insert Figure 2 near here **

Rehabilitative Phase 3 & 4 - Advanced Loading and Return to Sport (13-24 Weeks):

The goals of this stage were to restore full muscle maximal strength, power (rate of force development and acceptance, return to running and restore sport specific function (speed, agility, aerobic fitness, football specific skills). The player was allowed to run once he was able to single leg press 1.5 x bodyweight (BW) based on a submaximal estimation (Neto *et al.*, 2015) of 1 repetition maximum (RM).

Additional criteria required full knee ROM and no effusion. The player met the return to run markers at 15 weeks post-surgery comprising low intensity straight line running with gentle accelerations/decelerations and interspersed with walking initially (Juneau *et al.*, 2016). Running sessions twice weekly progressed at week 17 to three times weekly in order to monitor his symptom response. During this phase strength exercises were progressed in intensity through 8RM through to 4RM at week 17. Plyometric exercises were commenced at week 18 beginning, with foci in force production and subsequently force acceptance (Table 1). The player returned to squad training at week 21, the targeted start of pre-season. Initially the player trained every other day, but he did complete the full squad physical assessment battery which

highlighted improvements relative to pre-injury data and confirmed readiness to return to squad training and playing (see bottom of the table for these scores). Prior to returning to full training the player also achieved 2.1 x BW for single leg press (exceeding target 1.9 x BW), quadriceps isometric peak torque of 3.8 x BW (exceeding target 3.0 x BW (Kuenze *et al.*, 2015)). His single leg hop for distance was better on his injured side (2.05m) versus his uninjured side (1.99m; LSI = 1.03) The player returned to play during week 24, with playing time and training load producing an Acute:Chronic ratio of 0.8 - 1.3 (Gabbett, 2016).

Comparative Outcomes:

This case fits with the demographic of a male, in his second decade of life, and physically active. This case in an elite soccer player provided immediate access to imaging and specialist intervention. Diagnosis was made much earlier when compared to Cahill and Ahten's (2001) cohort, 80% of whom had pain for an average of 14 months prior to diagnosis, many of whom also developed a limp. OCD is long recognised but poorly understood due to its rarity, with the exact cause and natural history unknown (Edmonds & Polousky, 2013), adding to the challenge of accurately diagnosing and treating OCD. Edmonds and Polousky (2013) advocated conservative treatment for a stable OCD lesion, but in this case the orthopaedic consultant surgeon classified the lesion as unstable and requiring immediate surgical intervention to preserve the affected area. Evidence regarding OCD management is limited and typically refers to surgical management of OCD. Juneau *et al.* (2016) documented rehabilitation following surgical intervention of trochlear groove OCD categorising four stages of rehabilitation. Table 1 summarises the rehabilitation plan employed in the present case.

** Insert Table 1 near here **

Clinical implication:

To consider OCD as a possible cause of vague longstanding knee pain in young athletes, as early recognition and intervention has proved to be essential in this case due to the unstable lesion that could have had a catastrophic outcome. With early diagnosis, surgical intervention and a comprehensive rehabilitation plan this case concluded with a successful return to sport with no re-injury issues to date.

Declaration of interest statement

None reported.

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Figure 1. Pre-operative CT Scan image demonstrating the OCD lesion

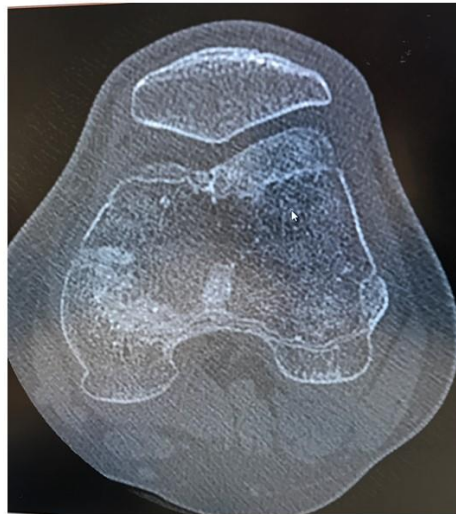


Figure 2. CT scan 12 weeks post-surgery demonstrating the OCD lesion has healed

Table 1. The 4-phase rehabilitation plan

Rehab. Phase	Wk	Overview/Focus	Primary Modalities & Exercise Focus	Milestones & Objective Measures
Acute / Unloading	1	Braced 0-30° Partial Weight Bearing	<ul style="list-style-type: none"> • Cryotherapy: Cryo-Cuff used for 25 minutes x 5 daily • Exercise Rehabilitation: Static quadriceps & glutes circuit (example below) <ol style="list-style-type: none"> 1. Straight leg raise (SLR) 10 second hold x 12 2. Side lying Abduction (SLR) 1- second hold x 12 3. SLR Alphabet x 3 4. Modified Clam (knee only flexed to 30°) x 15 5. SLR Circles x 12 6. Crunches x20 • Gait re-education: PWB gait drills to normalise gait pattern. • Electrotherapy: Electrostimulation high intensity muscle stimulation using muscle reconditioning programme (Bluetens) used twice daily • Manual therapy: patella glide mobilisations grade two (Maitland) (medial/ lateral/inferior/ superior) 3 x 30sec. In the 6th week knee flexion passive physiological mobilisations grade 2/3 to increase knee flexion to desired angle (10° per day). 	
	2			Surgeon Review
	3			
	4			
	5			VMO girth 36cm No knee joint effusion
	6	Opened Brace 10°per day Removal of Brace		
Moderate Loading	7	Upper body hypertrophy	<ul style="list-style-type: none"> • Aerobic Conditioning: Walking and cycling (from week 8) was utilised to develop the players aerobic zone fitness base • Exercise Rehabilitation: During this stage we focussed on closed kinetic chain exercises 0-60 initially to minimise PFJ strain. We began with focusing on activation and muscle endurance with 4 sets of 15 repetitions. As the weeks progressed the repetitions reduced as the weight increased to place more emphasis on muscle hypertrophy. At week 12 the player was performing 10RM intensity. • Example gym rehabilitation session 4 sets of: <ul style="list-style-type: none"> ○ Isometric squat 12 x 10s ○ Elevated feet bridge 12 x 10s ○ SLR alphabet writing x 6 ○ Single leg bridge 12 x 10s ○ Split squat hold 12 x 10s ○ Side lying hip banded abduction 12 x 10s ○ Single leg BW calf raise on step 	Full hyperextension
	8	Commenced low resistance bike work		
	9	Lower limb muscle activation, endurance and hypertrophy		Full flexion
	10			
	11			VMO girth 38cm CT scan

	12		<ul style="list-style-type: none"> • Gait re-education: FWB gait drills to normalise gait pattern, linked with aerobic conditioning • Soft tissue therapy: massage and trigger point release of quadriceps and gluteal muscles • Rest of the body: Identified that the player lacks upper body strength, this could be improved as part of the rehabilitation and recovery period for his injury 	
Advanced Loading	13	Hypertrophy and maximal strength range progressing from 10RM – 4RM	<p>Strength training geared towards maximal strength</p> <ul style="list-style-type: none"> • 8RM range for weeks 13/14 • 6RM range weeks 15/16 • 4RM range week 17. • Example max strength exercises: <ul style="list-style-type: none"> ○ Hex Bar Deadlift ○ Olympic Bar (OB) Romanian Deadlift (RDL) ○ OB Bulgarian Split Squat ○ Dumbbell (DB) Single Leg Calf Raise ○ OB Step up (High, step knee height) ○ Single leg hamstring curls ○ Single Leg Press ○ Hip Thrusts ○ Nordic hamstring curl 	Surgeon review of CT – lesion healed
	14			Single leg press 103kg = 1.5 x BW
	15	Return to running progressing	<ul style="list-style-type: none"> • Aerobic Conditioning: Running becomes the new exercise to continue the aerobic conditioning to the next level. Running sessions x 2 weekly with 2 days apart to monitor symptoms response. The running sessions included some basic ball manipulation and small passing on order to improve adherence and quality of the session in addition to meeting the specificity demands of the sport and his position (midfielder). • Running progressions: <ul style="list-style-type: none"> ○ Straight-line running with frequent rest breaks working 1:2 work rest ratio, progressing to 1:1 then 2:1. ○ Gradually increasing speed ○ Introducing accelerations but limiting decelerations ○ Introduction of gradual decelerations and progressing to short deceleration periods. ○ Figure of 8 running progressions ○ Cutting progressions (predetermined then command) 	Return to running
	16	introduction of Accel, Decel & COD		Introduction of ball manipulation work (basic level).
	17			VMO girth 40cm
	18	Plyometrics introduced to focus on restoration of full power	<ul style="list-style-type: none"> • Exercise Rehabilitation: Plyometric exercises integrated into strength routine in following order to focus on bilateral and unilateral leg power development rate of force production and rate of force acceptance. Box jumps. (up); weighted squat jumps (10% of bodyweight); depth jumps (gradually increasing height of the decent from box; single leg squat jumps. Progressed over 4-week period. 	

	19	Increased running load Position-specific competitive demands	<p>Aerobic Conditioning & Sport Specific Technical Skills:</p> <p>Running programme increased to three times weekly with one day rest in-between each session. One pitch-based running/functional rehabilitation was conducted and two gym/road/track running consisting of fartlek runs and interval running. This coincided with the off-season and therefore more regular pitch-based sessions weren't possible due to restrictions in facilities</p> <p>Sport Specific Tasks</p> <p>Once the player completed his return to running period and was able to tolerate accelerations and deceleration and CoD work focussed on position-specific tasks. He was a central midfielder.</p> <p>We began with aerobic development drills which typically had the player working at 70% of maximum for a period of 2–4 minutes, progressing through to working more intensely for 30-90s. We allowed more rest to begin with then started to decrease the rest period to replicate the demands of the sport.</p> <p>We focussed on all technical skills that would be required by the player; these included: short passing, long passing, dribbling, shooting, tackling and heading primarily.</p>																													
	20			VM0 girth 42cm																												
	21			<p>Isometric Quads</p> <p>HHD:</p> <p>Left 262N (3.8xBW)</p> <p>Right 264N (3.88xBW)</p> <p>Single Leg Press</p> <p>Left 142kg (2.1x BW)</p> <p>Right 145 kg (2.14 x BW)</p> <p>SL hop for distance</p> <p>R199cm L 205cm. LSI 1.03</p>																												
Return to Sport	22	Return to squad	<p>Summary of fitness tests</p> <table border="1"> <thead> <tr> <th>Test</th> <th>Pre-Injury</th> <th>Week 22</th> <th>Improved/Decreased</th> </tr> </thead> <tbody> <tr> <td>20m Sprint</td> <td>3.16</td> <td>3.13</td> <td>Improved</td> </tr> <tr> <td>T-Test</td> <td>18.74</td> <td>18.68</td> <td>Improved</td> </tr> <tr> <td>(CMJ): DL</td> <td>52</td> <td>54.8</td> <td>Improved</td> </tr> <tr> <td>CMJ: R</td> <td>34</td> <td>36.02</td> <td>Improved</td> </tr> <tr> <td>CMJ: L</td> <td>30</td> <td>34.16</td> <td>Improved</td> </tr> <tr> <td>VO2Max</td> <td>58</td> <td>60.5</td> <td>Improved</td> </tr> </tbody> </table>		Test	Pre-Injury	Week 22	Improved/Decreased	20m Sprint	3.16	3.13	Improved	T-Test	18.74	18.68	Improved	(CMJ): DL	52	54.8	Improved	CMJ: R	34	36.02	Improved	CMJ: L	30	34.16	Improved	VO2Max	58	60.5	Improved
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