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Research Article

Injury to the Calf Muscle Complex Following Recreational Sporting Activities

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Abstract

Calf muscle complex (CMC) injuries are well described in professional and semi-professional sports athletes.

The objective was to determine patient demographics, magnetic resonance imaging (MRI) findings and the factors that influenced return to pre-injury activity level in patients who sustained calf muscle complex injuries whilst engaged in recreational sports.

We prospectively reviewed 28 patients with CMC injuries confirmed by MRI in the period December 2016 to January 2018. Patient demographics, MRI findings and the return to pre-injury activity level were recorded.

A total of 24 males and 4 females with ages ranging from 29 - 57 years were reviewed. The majority of patients (75%) were less than 45 years old with unilateral limb affection.

In 20 (71%) out of the 28 patients a single muscle was injured and the medial gastrocnemius was the most commonly injured muscle (90%). Dual muscle injuries were observed in 8 patients (29%). In 82% of patients, MRI revealed interstitial oedema involving less than 50% of the injured muscles. Fluid collection/haematoma were observed in the MRI scans of 23 (82%) patients. In 20 out of 23 it was intermuscular. The mean time to return to pre-injury sports was 83 days, and this improved to 45 days in those who had physiotherapy as part of their treatment.

Calf muscle complex injuries do occur in adults of all ages who engage in recreational sports. The return to pre-injury activity level is prolonged though we believe this can be shortened with the inclusion of physiotherapy in the treatment plan.

Keywords: *Calf Muscle Complex; Injury; Recreational Sports; Return to Pre-Injury Activity; Physiotherapy*

Abbreviations

CMC: Calf Muscle Complex; MRI: Magnetic Resonance Imaging; US: Ultrasonography; PD: Proton Density; RICE: Rest, Ice, Compression, Elevation; NSAIDS: Non-Steroidal Anti-Inflammatory Medications; BMI: Body Mass Index

Introduction

Injury to the calf muscle complex (CMC) a relatively common clinical condition was first described in 1883 in Tennis players hence the name "Tennis leg" [1].

The classical clinical manifestation is a middle-aged person who experiences acute mid-calf pain in association with a snapping sensation while engaged in sports [2,3].

The patients are usually injured whilst undertaking active plantar flexion of the foot with simultaneous extension of the knee implying simultaneous contraction and passive stretching of the gastrocnemius muscle [4].

Ultrasonography (US) and magnetic resonance imaging (MRI) have been used as the primary imaging modalities for evaluation of patients with CMC injuries. Imaging not only confirms the diagnosis but determines the extent of injury and excludes other conditions such as deep vein thrombosis or knee ligament injuries [2,5-7].

We observed an increasing number of patients present to our clinics with CMC injuries. Interestingly all the patients we reviewed sustained their injuries whilst engaged in recreational sports and none of them were professional or semiprofessional sports personnel.

There have been a number of reports on CMC injuries in the English literature though they all relate to professional, semiprofessional or elite athletes with the emphasis on imaging findings [8-12].

In view of this, we undertook a prospective study in a group of patients who sustained calf complex injuries whilst engaged in recreational sports and had MRI scans. The purpose of this study was two-fold, first to identify the patient demographics and the pattern of muscle injury and secondly to identify the factors that influenced their return to pre-injury activity level.

Materials and Methods

After obtaining approval from the local ethics committee of our Institution, we undertook a prospective review of all patients who attended the Orthopaedic Department with calf muscle complex injuries between December 2016 and January 2018.

All adult patients who suffered calf muscle complex injuries whilst engaged in recreational sports, were not elite athletes and had MRI scans were considered eligible for the study.

The exclusion criteria included patients who had an injury more than two weeks prior to examination in clinic and had MRI scans that were negative for CMC injury.

Data collected included patient demographics such as age, sex, BMI and other information such as limb affected, time to presentation, activity leading to injury, MRI scan findings, treatment advised and time to return to sporting activity.

The initial diagnosis was made based on physical examination undertaken by (SJ, SK and BT) and was confirmed by MRI scan, which was the preferred imaging modality in our unit.

The MRI scans were undertaken within 2 days of the patient's initial presentation to the Orthopaedic clinic.

The MRI imaging technique involved placing an external marker over the site of maximal tenderness as indicated by the patient. The scans were undertaken in a 1.5 T MRI scanner. A dedicated surface coil was used to obtain high-resolution images with 2.5 mm axial proton density (PD) and PD fat saturated axial images as well as 2mm sagittal and coronal PD fat saturated images.

All the MRI scans were reported by a musculoskeletal radiologist. The radiologist was blinded to the patient demographics and other patient clinical information.

All the patients were reviewed in clinic within a week of the MRI scans being undertaken and the diagnosis relayed to them.

Treatment followed the RICE principle and at the first clinic visit the patients were advised rest, ice application, limb elevation and compression with a neoprene sleeve. They were also given a 2-week course of NSAIDS and a pair of crutches depending on the severity of pain and their ability to bear weight. They were then shown passive and active stretching exercises and referred for a course of physiotherapy. Review in clinic was undertaken at regular intervals with the final review 6 months after the initial injury.

Statistical analysis

Statistical analysis was undertaken using SPSS version 23. Categorical variables were compared using Fishers exact test due to the small sample size whilst continuous data were analysed using the Students t-test. Analysis of variance was used to compare the mean duration of return to preinjury activity level.

A p value of < 0.05 was considered statistically significant.

Results and Discussion

37 patients with calf muscle complex injuries were treated in our unit over the study period. Nine patients were excluded from this study leaving 28 patients for analysis (Table 1). Of the nine excluded, five were lost to follow up and four had symptoms for over a month before presentation.

There were 24 (86%) males and 4 (14%) females with ages ranging from 29 - 57 years (median 39 years).

The majority of patients (75%) were less than 45 years old. There was no direct relationship between Body mass index (BMI) and severity of injury.

All injuries were unilateral and the right side was involved in 9 (32%) whilst the left in the remaining 19 (68%) patients.

The time to presentation following the initial episode ranged from 1 - 14 days (average 2.7).

The majority of the injuries were acute (93%). Injuries were defined as acute if the patients were seen within 10 days of the initial injury and subacute if after 10 days.

The sporting activities relating to the respective injuries included football (32%), basketball (14%), tennis (11%), baseball (3.5%), rugby (3.5%), volleyball (3.5%), cricket (3.5%) and running (29%). None of the patients were professional, semiprofessional, or elite athletes. All patients undertook these activities for recreational reasons.

In 20 (71%) out of the 28 patients the calf muscle injury involved a single muscle. Of these patients with a single muscle injury the medial gastrocnemius (Figure 1 and 2) was the most commonly injured muscle (90%) whilst the lateral gastrocnemius was injured in two patients (10%). No patient had a plantaris muscle injury.

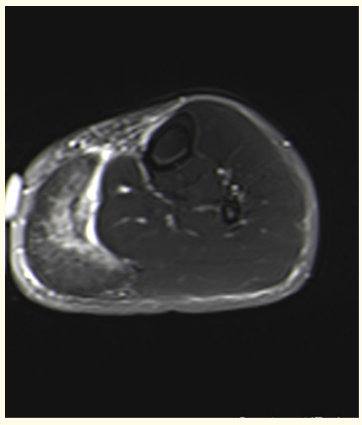

Figure 1: *Axial Proton Density fat saturated image through the left calf showing medial gastrocnemius injury with intermuscular haematoma interposed between it and the soleus.*

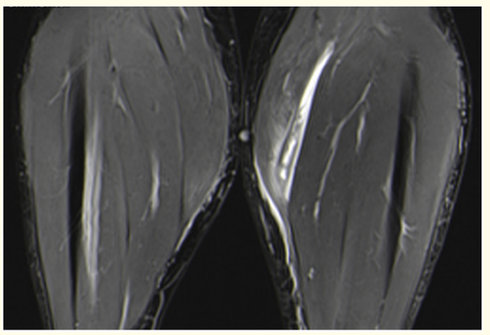

Figure 2: *Sagittal Proton Density fat saturated images showing image of left calf with medial gastrocnemius muscle fibrillary disruption and intermuscular haematoma.*

Eight patients had dual muscle injuries and the muscles injured are depicted in table 1.

Patient	Age (Years)	Sex	Limb	Time to presentation (days)	Activity causing injury	Muscle(s) involved	Intersitial Odema (%)	Fluid collection	Physiotherapy
1	29	F	R	1	Running	Medial gastrocnemius	25 - 49	No	No
2	43	M	R	14	Football	Medial + lateral gastrocnemius	< 25	Yes	No
3	43	M	R	1	Basketball	Medial gastrocnemius	> 50	Yes	Yes
4	41	M	R	1	Tennis	Medial gastrocnemius	25 - 49	Yes	No
5	37	M	R	**1**	Football	Medial gastrocnemius	25 - 49	Yes	No
6	39	M	L	3	Basketball	Medial gastrocnemius	< 25	Yes	Yes
7	57	F	L	7	Running	Medial gastrocnemius + Soleus	< 25	Yes	No
8	37	M	L	1	Volleyball	Medial + lateral gastrocnemius	< 25	Yes	No
9	34	M	L	1	Running	Medial gastrocnemius	< 25	Yes	No
10	29	M	L	1	Running	Medial gastrocnemius	< 25	Yes	No
11	34	M	L	1	Tennis	Medial gastrocnemius	< 25	Yes	No
12	32	F	L	2	Rugby	Medial gastrocnemius	25 - 49	Yes	No
13	36	M	L	14	Football	Medial gastrocnemius	< 25	No	No
14	45	M	L	**1**	Football	Lateral gastrocnemius + Soleus	< 25	Yes	No
15	43	M	R	**1**	Baseball	Medial gastrocnemius + Soleus	< 25	Yes	No
16	45	M	R	1	Tennis	Medial gastrocnemius	25 - 49	Yes	No
17	45	M	R	7	Running	Medial gastrocnemius	25 - 49	Yes	No
18	55	M	L	1	Running	Medial gastrocnemius	< 25	Yes	Yes
19	33	M	L	1	Football	Medial gastrocnemius	> 50	Yes	Yes
20	29	M	L	1	Football	Lateral gastrocnemius + Soleus	> 50	No	No
21	47	M	L	1	Football	Medial gastrocnemius	< 25	No	No
22	34	M	L	**1**	Basketball	Medial gastrocnemius	< 25	Yes	No
23	40	M	L	**1**	Running	Medial gastrocnemius + Soleus	> 50	Yes	No
24	53	F	L	2	Running	Lateral gastrocnemius	< 25	No	No
25	41	M	L	7	Football	Medial gastrocnemius	25 -4 9	Yes	Yes
26	35	M	L	1	Football	Medial + lateral gastrocnemius	25 - 49	Yes	No
27	37	M	R	1	Basketball	Medial gastrocnemius	> 50	Yes	No
28	39	M	L	1	Cricket	Lateral gastrocnemius	25 - 49	Yes	Yes

Table 1: *Shows demographics of patients including MRI findings and physiotherapy treatment.*

M: Male; F: Female, R: Right; L: Left.

In the majority of patients (23/28; 82%) MRI revealed interstitial oedema involving less than 50% of the injured muscle cross-section. In 60% of these patients the respective muscle involvement was less than 25%.

Fluid collection/haematoma was observed on the MRI scans of 23 out of the 28 patients (82%). The fluid collection/haematoma tracked in the intermuscular fascial planes in 20 of the 23 (87%) cases. In the remaining 3 (13%) cases the haematoma was intramuscular. No patient required surgery to drain a haematoma or repair the muscle injury.

In all patients, there was no associated knee ligament or Achilles tendon injury though two patients had an associated deep vein thrombosis that required treatment.

Of the 28 patients, 24 returned to their pre-injury activity level. The time to recovery and return to activity/recreational sports for the whole group ranged from 32 - 120 days (mean 83 days). In those who underwent physiotherapy as part of their treatment it was 32 - 58 days (mean 45 days) and in those who did not attend physiotherapy it was 50 - 120 days (mean 95 days).

We could not determine the recovery time in 4 patients who had not returned to preinjury activity level by the time of the final follow up. The reasons for not returning were too busy at work hence no time and no motivation.

Univariate analysis was undertaken to establish the factors that caused a delay of more than 45 days to return to preinjury activity level/ sports. The lack of physiotherapy was the only variable that directly correlated with a delay to return to activity level/recreational sports of more than 45 days ($p = 0.0184$). Factors such as patient age, type of activity causing injury, muscle injured, number of injured muscles, MRI findings such as fluid collection and interstitial oedema involving the injured muscle(s) did not correlate with a delay to return to activity level.

Discussion

Calf muscle complex injuries or tennis leg was first described by Powell as a clinical condition that predominantly affects the middle-aged person [1].

The Oxford dictionary defines the middle aged as a person between the ages of 45 and 65 years. In our study only 25% of patients were considered middle aged (greater than 45 years old) thus refuting this belief that CMC injuries are an injury of the middle aged person. The age range was from 29 - 57 years with the majority of patients in the fourth decade of life.

Like previous reports on this injury (though most relate to professional/semiprofessional or elite athlete and our study relates to people undertaking recreational sports) males were more commonly affected than females [8,13].

Although CMC injuries have been described following sporting activities such as tennis, American football, Australian football, cricket, rugby and hockey [8-10,12] it has also been reported following activities such as running [5]. Almost a third of our patients suffered a CMC injury whilst running without participating in a particular sporting activity.

Physical examination (i.e. palpation, strength assessment and stretching) has been shown to be a reliable method of diagnosing CMC injury [13-15]. In the current study all the patients who were thought to have CMC injuries following clinical examination were confirmed to have such injuries on MRI.

We chose MRI as our imaging modality as previous reports have suggested that ultrasonography is not sensitive enough to detect all the injuries and leads to under-diagnosis [11,16]. Balius., *et al.* [11] in a comparative study involving MRI and Ultrasonography confirmed that ultrasonography was not able to detect injury to the soleus in 27% of their cases.

The most commonly injured muscle in our study was the medial gastrocnemius muscle. This is in keeping with previous reports [13,14,16-18]. The propensity for the medial gastrocnemius to be the most commonly injured calf muscle is believed to be due to the following factors. The medial gastrocnemius muscle crosses two joints and has a longer attachment than the lateral thus has a capacity to generate high intramuscular forces during passive stretching associated with normal movement. In addition, it has a high proportion of fast twitch fibers that allow for rapid eccentric contraction which is when muscle fibers are susceptible to injury [8].

Though most calf muscle complex injuries involve a single muscle, dual and quadruple muscle injuries have also been reported [9]. The reported rate of dual muscle injury detected by MRI ranges between 8 and 33% [8-10].

In our series it was 28%. None of the patients in our cohort had a quadruple muscle injury. This we believe is because the level of participation of our patients was not as intense of that of professional or semi-professional athletes.

Fluid collection seen on MRI/Ultrasonography between the aponeurosis of the medial head of Gastrocnemius and Soleus has been reported to signify disruption of the medial head of gastrocnemius or plantaris at the level of the muscle belly or musculotendinous junction [5,19]. This fluid collection is considered to represent a haematoma. Delgado., *et al.* [5] observed a fluid collection in this location in more than 50% of their patients with ruptures of the medial head of the gastrocnemius. We observed a fluid collection in 60% of the patients in our study with injuries of the medial head of gastrocnemius.

Treatment of CMC injuries usually involves a conservative approach involving ice, elevation, walking aids, NSAIDs with or without the use of neoprene sleeves [15,17,18,20]. Six patients in our study received physiotherapy in addition to the above.

The time to recovery following a CMC injury to the previous pain free activity level has been reported to vary.

Pedret., *et al.* [21] in their report of 61 professional athletes with isolated soleus injuries following various sporting disciplines such as soccer, basketball, triathlon and field hockey reported a median time to recovery of 29.1 days.

Prakash., *et al*. [9] in their series involving 100 patients who were professional, semiprofessional or elite athletes reported a mean recovery time of 8.1 days in those with mild injury and 52 days in those with severe injury.

A report by Werner., *et al.* [10] involving 24 American football league players noted a mean time to return to play of 17.4 days.

In our series the mean time to recovery for the whole group was 83 days. This improved to 45 days in those who had physiotherapy.

The time to recovery and return to sports has been suggested to be linked to various features on MRI such as the presence of a fluid collection, large size of facial defect and the grade of connective tissue injury. Though we believe these MRI features are relevant we did not observe any correlation between some of them and the return to pre-injury activity level in our cohort of patients.

We believe our cohort of patients took much longer to recover than those in the reports of Pedret., *et al.* Prakash., *et al.* and Werner., *et al.* because the patients in those studies were all professional or semi-professional athletes with structured rehabilitation programmes, guidance and motivation to return to sports as soon as possible whilst this was not the case in our patients. We believe all patients with CMC injuries should receive structured physiotherapy as part of their treatment to shorten the recovery time.

Our study has a number of limitations. The first is the small sample size which results in under-powering and type II statistical error. We recognize that the time to return to pre-injury activity level/sports may vary depending on the time of the year, weather conditions, type of sports engaged in and the level of motivation. Finally, this study did not utilize any validated outcome measures as the authors are not aware of any validated outcome measures for calf muscle complex injuries.

Conclusion

Injury to the calf muscle complex does not only occur in professional athletes but also adults of all ages who engage in recreational sports. The return to preinjury activity level in people who engage in recreational sports is prolonged though we believe this can be shortened with the inclusion of a structured physiotherapy programme in the treatment plan.

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Conflict of Interest

None of the authors have any conflicts of interest to declare.

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