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Original Article

Recovery of knee function in the isolated MCL and combined ACL–MCL deficient knee

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ABSTRACT

Background: The MCL is the prime medial stabiliser of the knee and is a commonly injured structure which leads to valgus instability of the knee.

Objectives: We aim to analyse differences in recovery of knee motion and muscle function over one year follow up in the isolated MCL and combined ACL–MCL injured knee. We hypothesized that combined ACL–MCL injuries lead to greater knee motion and muscle function deficits at 1 year.

Methods: Isolated MCL (Group I) or combined ACL–MCL injuries (Group II) from 2006–2010 were included. Those with a previous MCL injury, injury to contralateral limb or presenting 2 weeks post-injury were excluded. At certain outpatient follow up intervals, we recorded pre-determined parameters of knee function. Follow-up was at weeks 2, 6, 12, 26, 52.

Results: The cohort included 82 patients (54 males:28 females) with a mean age of 32 (range 16–56). Group II showed a deficit in Total Range of Movement (TROM) and flexion at 6 month follow up ($p < 0.05$). Group II showed an extension deficit at week 2 ($p < 0.05$). The Peak Torque Deficit (PTD) and Average Power Deficit (APD) improved for quadriceps and hamstrings across all follow up intervals ($p > 0.05$).

Conclusion: There is a TROM and flexion deficit at 6 months in group II, resolving by 1 year. There was no difference in PTD or APD in either group.

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1. Introduction

The medial collateral (MCL) and anterior cruciate ligaments (ACL) are two key structures that provide stability to the knee during weight bearing and movement. The type of instability pertains to the injured ligament, with the MCL causing valgus

instability and the ACL leading to anterior and antero-lateral rotatory instability.¹

The MCL is the most commonly injured ligamentous structure of the knee. Being the prime medial stabiliser of the knee, its treatment is of considerable importance and still a source of some debate. Presently, there is no standardized

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treatment particularly in isolated MCL injuries, with options ranging from surgical management of all cases, to conservative management of every case.²

Grade III MCL lesions have a near 80% incidence of concomitant ligamentous damage and in over 90% of cases an ACL is torn,² thereby heavily influencing the prognosis of an MCL injury. Optimal management of combined ACL–MCL injuries is also highly debatable. There is no standard consensus of treatment with some studies suggesting operative intervention for both ligaments^{2,3} and others suggesting a more conservative approach.^{4,5} Many surgeons however, are proponents of operative intervention for the ACL only.^{6–9} The debate revolves around clinical outcomes for this type of injury, mainly range of motion, extension and flexion deficit as well as quadriceps function. In this prospective study we aimed to evaluate outcomes in muscle function and knee motion recovery at 1 year follow up of patients with an isolated MCL and combined ACL–MCL injury.

2. Patients and methods

Our raw database of eligible candidates for the study contained 115 patients that met the inclusion criteria. Thirty-three patients were further excluded due to non-attendance at arranged follow up clinics leaving 82 who were analysed. Group I patients were those that incurred an isolated MCL injury. Group II patients had a combine ACL–MCL injury. Out of the 82, group I included 51 patients leaving 31 patients in group II. All of the data collected for analysis had a parametric distribution. The mean age for both groups was 31.7 (range 16–56), and there were 54 males and 28 females. Most patients had an MCL grade 2 injury, 71% in group I and 68% in group II. The remaining demographics for both groups can be viewed in Table 1.

Of all patients, 32% of injuries were sustained following a twisting mechanism with the next commonest from a valgus injury (23%) as seen in Table 2. Of those sustaining twisting injuries, 18 (69%) were as a result of sport and the remaining 8 (31%) as a result of falls. The majority of group II patients (65%) underwent ACL reconstruction surgery with surgery undertaken within 6 weeks. Two patients with grade II MCL injury in group I experienced continued knee instability after 6 month clinic follow up and underwent subsequent surgery (Table 3).

Patients who had incurred either an isolated MCL (Group I) or combined ACL–MCL (Group II) injury of the knee were seen at a soft tissue knee injury clinic between 2006 and 2010 at the Royal infirmary of Edinburgh within a 2 week window following initial presentation to the emergency department. The senior author saw all patients at the knee clinic and an isolated MCL injury would be diagnosed clinically and allocated to group I. All group I patients were treated

nonoperatively following initial consultation. Based on the history and clinical examination at initial consultation, if there was suspicion of injury to the ACL, an MRI would be requested and carried out as an outpatient. All patients had X-rays by the time of initial consultation to rule out concomitant fracture. If MRI demonstrated ACL tear amenable to reconstruction then surgery would be offered. Patients who did not wish to undergo surgery underwent rehabilitation as per the Lothian Physiotherapy Orthopaedic Guidelines. All patients had data collected prospectively on a database for the duration of the study. Exclusion criteria for the study included patients presenting >2 weeks following injury, a previous MCL injury, and patients with a contralateral knee injury. Patients in both groups were treated with a hinged brace for 6 weeks if they had a grade 2 or 3 MCL injury or unprotected mobilisation for grade 1 injuries. Patients with symptomatic instability of the knee following initial rehabilitation were offered ligament reconstructive surgery. All procedures were carried out by the senior author.

We recorded demographic data for each patient including age, sex, and mechanism of injury. The diagnosis of MCL and ACL injury was based on the history and physical findings supplemented by plain radiographs and MRI scanning. The parameters measured for analysis included total range of movement (TROM), extension deficit, flexion deficit, peak torque deficit (PTD) and average power deficit (APD) for flexion and extension.

All patients were followed up for 1 year. None were lost to follow up. Clinical assessment was made at 2, 6, 12, 26 and 52 weeks by a physiotherapist who measured range of movement and carried out isokinetic testing for the other endpoints. Follow up data in this study refers to measurements collected following definitive management agreed and undertaken ie non-operative versus operative. Range of knee movement was measured using a long arm goniometer. Iso-kinetic muscle testing of the quadriceps and hamstring muscles was carried out using a dynamometer (Biodex system 2; Biodex medical systems, Shirley New York). This measured isokinetic peak torque, total work and average power for flexion and extension of the knee. Each evaluation consisted of an active warm up period followed by repetitions carried out at speeds of 180°/second for the knee joint. For the purposes of the study the median speed of 180 was used as it has previously been shown that there is a strong correlation between the 3 parameters (peak torque, total work and average power) at varying dynamic speeds.^{10,11}

Values of the uninjured limb were measured for comparison as this was considered normal for the patient. Range of Movement and parameters of muscle function were calculated as a percentage of the normal side. A t-test was used to compare the two groups. Statistical analysis was initially

Table 1 – Patient demographics.

Group	Age (SD)	Sex (M:F)	MCL grade (1:2:3)
Both	31.4 (11.0)	54:28	17:57:8
I	32.1 (11.3)	32:19	14:36:1
II	30.4 (10.4)	22:9	3:21:7

Table 2 – Mechanism of injury for both groups.

Mechanism	Group I	Group II
Twist	16	10
Valgus injury	14	6
Direct blow	2	1
Unknown	19	14

Table 3 – Treatment of patients.

Treatment	Group I	Group II
Surgery	2	20
Hinged brace	25	18
Unprotected mobilisation	26	13

extracted from Excel[®] and transferred onto Graphpad Prism[®] for final analysis once the data had been validated and formatted. A p-value of <0.05 was considered significant.

3. Results

3.1. Range of movement

The total range of movement (TROM) was reduced in both groups at all follow up intervals including at 1 year. This improved over the course of the year. The improvement was evident clinically and most pronounced over the first 12 weeks. At 6 month follow-up, the difference in TROM was statistically significant with group II showing a greater deficit (Table 4, Fig. 1). Flexion deficit also followed a similar trend, being most pronounced over the first three months and clinically improving on examination over the same period. There was an increased flexion deficit in Group II at 6 month follow up which was statistically significant (Table 4, Fig. 2). Both TROM and flexion deficit at 6 months improved at 1 year follow up with no significance in the difference between the groups. Extension deficit uniformly decreased throughout the year in both groups, with significance at week 2 follow up ($p < 0.05$).

3.2. Peak torque deficit

This was measured at 6 weeks onwards. Quadriceps PTD showed a deficit in both groups at all time intervals. This steadily improved over the year. Hamstrings PTD showed a markedly sharp improvement in both groups from week 6–12, however this sharply rose again at 6 month assessment for group II ($p > 0.05$). Group I showed a more sustained improvement overall. Both groups had a deficit in hamstrings ROM at 52 weeks. These results were not significant ($p > 0.05$).

3.3. Average power deficit

Muscle power deficit for quadriceps and hamstrings still remained in both groups at 6 month and 1 year follow up with a steadily improving trend. Both groups demonstrated an increase in hamstrings deficit at 1 year follow up which was not significant ($p > 0.05$). The results for quadriceps power were similar and equally insignificant (Table 5).

4. Discussion

Isolated injuries to the medial side of the knee, in particular the medial collateral ligament, have received little attention in the literature. This is primarily due to a focus on the anterior and posterior cruciate ligaments as well as postero-lateral corner injuries. For this reason, there is a discernible lack of evidence looking at knee motion and muscle recovery following isolated MCL disruption. The management options for MCL injuries are mainly guided by clinical examination and if grade I or II injuries are identified with the aid of imaging then non-operative treatment is mainstay. This consists of extensive physiotherapy with either hinged bracing or unprotected mobilisation.^{2,12–14} In our study 96% of group I patients were non-operative. Options for MCL grade III injury is a little more debatable, mainly due to associated ACL and postero-medial corner injuries.¹⁵

We have demonstrated that at 6 month follow up an ACL–MCL injury will likely lead to a TROM and flexion deficit compared to an isolated MCL injury. However, both of these outcomes will improve over the following 6 months to an insignificant difference between both groups. Both groups showed a gradual improvement with regards to peak torque and average power up to 1 year follow up with no significant difference in both injury types.

To the best of our knowledge, our prospective study is the largest to comprehensively follow a cohort over a 1 year period and assess objective functional outcomes in isolated MCL injuries, comparing them to combined ligament injury. We standardized measurement of reported outcomes by using a long arm goniometer and dynamometer operated by the same physiotherapist. This enabled accurate range of movement and isokinetic muscle testing whilst eliminating interoperator error. All patients who underwent surgical procedures were operated on by the same senior author. Our main limitation was that both groups were not homogenous

Table 4 – Total range of movement (TROM), Extension (hamstrings) and flexion (quadriceps) deficit expressed as a mean percentage of the uninjured side.

Follow-up (wks)	TROM Def		Ext deficit		Flex deficit	
	Group I	Group II	Group I	Group II	Group I	Group II
2	29.8	38.6	6.8*	9.9*	23.0	28.7
6	12.6	17.5	3.9	5.3	8.8	12.3
12	6.7	8.4	2.4	3.2	4.3	5.2
26	3.6*	9.5*	2.1	2.8	1.7*	6.7*
52	5.4	8.1	1.2	2.5	4.2	5.6

*significant, $p < 0.05$.

Fig. 1 – Mean deficit between groups at follow up. Significant greater 6 month deficit in TROM for group II.

Fig. 2 – Flexion deficit between groups at follow up. Significant greater 6 month flexion deficit for group II.

in MCL injury grade. This led to varying treatment options for both groups, with not all group II patients undergoing surgical reconstruction for example. This is worth considering when looking at our results. Additionally, subjective patient rating of outcomes at follow up was not included in our study.

There have been several studies performed evaluating knee function following combined ACL–MCL injury with well-known knee motion complications following ACL reconstruction. Harner et al have already shown that concomitant MCL injuries adds to this risk.¹⁶ This justified our hypothesis that combined ACL–MCL injuries lead to greater knee motion and muscle function deficits at 1 year follow up compared to isolated MCL injury.

The argument for which intervention to use for combined ACL–MCL injuries remains debatable. The current consensus seems to be reconstructing the ACL with non-operative treatment of the MCL. The main argument for this is that

the ACL tears generally are functionally complete and do not heal. If the ACL is reconstructed, it enhances knee stability which will minimise the risk of late MCL instability. Halinen has published two studies on this topic looking at early ACL reconstruction with non-operative management of the MCL injury. Their initial study was a prospective randomised control trial following 47 patients with group I undergoing ACL and MCL reconstruction, and group II only undergoing ACL reconstruction. At 24 month follow up, there was no statistically significant difference in knee stability, motion and muscle power. Lysholm and IKDC scores were also similar.¹⁷ In their second publication looking at the same cohort, they looked at whether early ACL repair affected the above outcomes. They concluded non-operative intervention for MCL injury in combined ACL–MCL disruption was more favourable due to faster restoration of quadriceps and flexion muscle power.¹⁸ Similarly, Millet et al studied 18 patients in 2004 looking at early ACL reconstruction with conservative management of at least an MCL grade II. They reported excellent functional outcomes and muscle strength with low motion complications at 2 year follow up. Lysholm and Tegner scores were also high (94.5 and 8.3 respectively).¹⁹ This interventional method is further backed by several other studies. In a series of 68 patients by Shelbourne and Porter, ACL injuries were reconstructed with MCL injury treated non-operatively. Similar excellent functional and stability outcomes were seen with good subjective rating of pain, swelling and stability. They also showed greater range of motion with more rapid muscle strength gains as opposed to surgical reconstruction of both ligaments.²⁰ The same result was shown by Noyes and Barber-Westin, concluding that non-operative intervention of the MCL was best.²¹ Extensive literature search has found several other clinical studies advocating ACL reconstruction only and whilst not testing as many functional outcomes as in our study, they make a compelling case.^{6,8}

In contrast, there are proponents of reconstructing the MCL without ACL repair with Shirakura et al reporting high Lysholm scores and Barrett quoting 94% for the proportion of cases that returned to pre-injury levels.²² This however, remains an unpopular management choice. Non-operative treatment of both ligaments remains poorly utilised following a study by Fetto et al, with almost 60% of their study patients requiring operative treatment at follow up.²

The above literature search highlights the debatable nature of how best to manage combined ligamentous injury. Therefore, for the purposes of this study we did not factor type of intervention for combined ACL–MCL injury as part of our analysis.

Table 5 – Peak torque deficit (PTD) in extension and flexion as mean percentage of uninjured limb. Also seen is the average power deficit (APD) of extension and flexion.

Follow-up (wks)	PTD Ext		PTD Flex		APD Ext		APD Flex	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
6	19.7	19.9	15.7	14.2	20.8	20.0	22.6	16.6
12	13.5	15.9	5.5	8.1	11.9	11.5	6.1	10.6
26	13.7	11.6	3.3	10.6	13.6	8.2	5.3	5.9
52	10.7	12.3	8.4	6.3	7.4	8.2	10.0	7.1

5. Conclusion

Patients who had a combined ACL–MCL injury were more likely to have a deficit in total range of movement and overall flexion compared to isolated MCL injuries at 6 months. This resolved to a statistically insignificant deficit at 1 year. Average muscle power and peak torque were similar in both groups at 1 year follow up with no associated significance. Our above findings can be used to guide prognosis and advise patients of their progress at follow up intervals. In future, it would be valuable to subjectively evaluate outcomes using the IKDC and KOOS to complement our objective outcomes.

Conflicts of interest

All authors have none to declare.

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