

Research Report

AUSTRALIAN SURVEY OF INPATIENT MANAGEMENT FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Abstract: A reliability-tested questionnaire was used to survey current inpatient practices of Australian physiotherapists following anterior cruciate ligament (ACL) reconstruction. A response rate of 76% was achieved (248 of 326 hospitals), producing an overall sample of 84 respondents where ACL reconstructions were performed. Rehabilitation protocol development was commonly a collaborative effort between surgeons and physiotherapists. Two-thirds of hospitals had revised protocols within 2 years prior to the survey. Quadriceps and hamstring exercises were typically commenced by the first postoperative day. The most common quadriceps exercises prescribed were isometric quadriceps, straight leg raises and inner range quadriceps. Hamstring exercises most frequently performed were co-contractions and isolated hamstring contractions. Continuous passive motion, electrotherapy, bracing and cryotherapy were not enthusiastically incorporated. Discharge trends reflected aggressive rehabilitation inclinations, with patients typically discharged by the second or third postoperative day. The most common discharge expectations were unprotected weight bearing, up to 90° of knee flexion, and terminal extension. The most common discharge criterion from both physiotherapy and hospital was safe and independent mobility. This pioneering survey of inpatient practices following ACL reconstruction identified a non-uniform range of regimens currently implemented among Australian hospitals, but there was earlier implementation of those used than had been previously reported.

Key words: anterior cruciate ligament, reconstructive surgical procedure, inpatient, clinical protocols

Introduction

There has been a steady increase in the number of anterior cruciate ligament (ACL) reconstructions performed in the Western world, which is reflected by statistics adapted by the American Academy of Orthopedic Surgeons from the National Center for Health Statistics [1]. While complete figures are only available from 1994–1996, the total number of ACL reconstructions performed annually had increased from 85,000 to 107,000 during this period. Australian figures relating to ACL reconstructions are not readily available. A MEDLINE search using “anterior cruciate ligament” as a

key phrase revealed that there were twice as many published articles relating to ACLs in the period 1996–2002 as were published between 1989 and 1995.

The importance of rehabilitation in determining the outcome of ACL surgery is well known, but much of the literature has focused on the later rehabilitation stage [2–5]. While a comprehensive early management regimen presented in a recent paper by Wilk et al indicates a growing emphasis on this acute phase [6], recommended protocols specific to the early postoperative period have previously been few. Furthermore, while physiotherapists are largely responsible for the supervision and progression of routines, management has most

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frequently been investigated from the perspective of the surgeon [2,7; also GYF Ng, PhD, unpublished data, 1995]. Despite the proliferation of ACL reconstructions, no published studies have investigated postoperative management regimens specifically in an Australian population.

There are few comprehensive overviews or systematic reviews of acute postoperative management of ACL reconstruction. Conversely, there are a variety of studies investigating specific aspects of physiotherapy management following ACL reconstruction [8–11]. These aspects have included: strengthening exercises for quadriceps, hamstrings and calf; knee and ankle range of movement exercises; postoperative use of modalities; existence of and responsibility for developing and updating a protocol of management; and criteria for discharge. Moreover, rarely do studies consider the decision-making process or the strength of evidence concerning which specific interventions should be investigated.

This observational study aimed to identify, from the perspective of physiotherapists, the current Australian postoperative inpatient protocols for management following ACL reconstruction. A subset of this survey, presented previously by Shaw et al [12], reported only the prevalence of quadriceps exercises after ACL reconstruction. In contrast, this paper aims to present which specific exercise regimens were used in acute postoperative management of ACL reconstruction, weight bearing and discharge criteria and the variety of additional modalities currently in use.

Methods

The Divisional Ethics Committee of the University of South Australia granted ethical approval for this study in November 2000 and the data were collected in 2001.

Development of the questionnaire

Of the previous studies that investigated ACL rehabilitation [4,7,13,14; also GYF Ng, PhD, unpublished data, 1995], none established the reliability and validity of the survey instrument. In the current study, the questionnaire was developed in three phases: establishment of face and content validity using experts, field testing and test of reliability. A sample of 32 hospitals produced a minimum of 70% test-retest agreement for each individual question of the questionnaire.

The final six-page questionnaire consisted of two parts. Part A contained 10 questions pertaining to demographic information of the institution. Part B consisted of 23 questions on the acute care management routine and protocol at the hospital. Data were sought about which exercises, modalities and techniques were routinely performed following ACL reconstruction, and on what day after surgery they were commenced.

Additionally, data were sought on bracing practices, range of movement, strengthening exercises, weight-bearing practices, supplementary modalities, discharge criteria and responsibility for protocol development. Most questions were closed (“yes/no” – categorical data). Of the open-ended questions, responses provided either ratio data or an opportunity for further comment.

Main study

The Australian Physiotherapy Association maintains a database of Australian hospitals, although this database is not limited to orthopaedic hospitals where ACL reconstructions are performed. It was acknowledged that this sampling method would recruit many institutions unable to participate fully in the study. The questionnaire, an information letter and a reply-paid envelope were sent to the senior orthopaedic physiotherapist within each hospital. All participants were asked to complete the questionnaire, even if just to respond to the first question about whether or not ACL reconstructions were performed, and return it in the enclosed reply-paid envelope to the investigators. Those hospitals that did not return questionnaires were given one reminder telephone call. Completion and return of the questionnaire was assumed as consent for participation in the study.

Statistical analysis

Data from the completed questionnaires were entered into a spreadsheet following numerical coding. Responses from the questionnaires provided categorical, interval and descriptive data. Analysis of results from the study involved the representation of the different sets of data using percentages, frequency distributions and the identification and quantification of common themes and phrases.

Results

Questionnaires were sent to 326 hospitals and 248 questionnaires were returned (76%). A number of hospitals indicated that they did not perform ACL reconstructions and, therefore, these questionnaires were removed from further analysis, leaving 84 complete sets of data.

When asked whether a defined protocol was used to manage patients during the inpatient period following ACL reconstruction, 74 hospitals (88%) responded positively, seven hospitals (8.3%) reported no defined protocol, two hospitals (2.4%) were unsure if a protocol existed and the remaining one hospital (1.2%) did not respond. With regard to who was responsible for developing postoperative management protocols, 20% ($n = 17$) were developed exclusively by the orthopaedic surgeon and 10% ($n = 8$) were developed solely by the physiotherapist, while 61% of hospitals ($n = 51$) re-

ported that the protocol was a collaboration between the surgeon and physiotherapist. A further 2% ($n = 2$) reported involvement of the nursing staff in protocol development, while in 7% ($n = 6$) of questionnaires, this question was not answered.

With respect to when the ACL management protocols had been most recently updated, 13% of hospitals ($n = 11$) had revised their protocols during the year of data collection for this study (2001); 32% of hospitals ($n = 27$) had updated protocols in 2000, and 18% of hospitals ($n = 15$) had updated protocols in 1999, while 13% of hospitals ($n = 11$) had not revised their protocols since prior to 1999. Fifteen percent ($n = 13$) could not identify when their ACL management protocols had been most recently updated, while for 8% of hospitals ($n = 7$), a response was not appropriate as a protocol for management did not exist.

Exercises

Quadriceps exercises used were reported in detail by Shaw et al [12]. In summary, these included isometric quadriceps contractions performed in 91% of hospitals surveyed, straight leg raises (SLR) used in 49% and inner range quads (IRQ) in 30%. These exercises were usually commenced by the first postoperative day.

Hamstring-specific exercises were prescribed by 23 of the 84 surveyed hospitals during the acute postoperative period. A further 28 hospitals also indicated that hamstring exercises were performed as part of co-contraction exercises. The day of commencement of hamstring exercises is presented in Figure 1. Seven hospitals specifically stated that hamstring exercises were not performed, while three hospitals failed to respond to this section of the questionnaire. Of the listed exercises, the most commonly prescribed hamstring-specific exercises were through range contractions in prone ($n = 22$) and standing positions ($n = 16$), and isometric hamstring contractions in prone ($n = 12$) and standing positions ($n = 11$). Additional hamstring exercises reportedly used by surveyed hospitals included static contractions in supine ($n = 16$), through range in side-lying ($n = 6$), through range in sitting positions

($n = 2$) and bridging ($n = 1$).

A number of other exercises were reported that were not specifically for either the quadriceps or hamstring muscles. These included general co-contractions ($n = 50$; 60%), gluteal exercises ($n = 37$; 44%), calf exercises ($n = 15$; 18%), hip abduction ($n = 7$; 8%), foot and ankle exercises ($n = 5$; 6%), hip adduction ($n = 3$; 4%), good leg exercises ($n = 1$; 1%), hip extension exercises ($n = 1$; 1%) and bridging ($n = 1$; 1%).

Additional modalities

A number of additional treatment techniques, modalities or strategies were used for acute management of ACL reconstruction patients. Postoperative bracing was used at 44 hospitals (52%), with 35 hospitals using rigid braces, seven hospitals using braces that permitted limited movement, and two hospitals using braces that allowed full movement. The period for bracing was most often 1–2 weeks (21 hospitals, 48%), with six (14%) bracing for up to 6 weeks and five (11%) until quadriceps/SLR control was considered “good”. In 12 hospitals (27%), duration of bracing was unknown or no answer was given.

Cryotherapy was used by 71 (85%) of the hospitals surveyed, with 30 (42%) routinely using cryotherapy and 41 (58%) reportedly using cryotherapy only occasionally. Electrotherapy modalities were only used routinely by one of the surveyed hospitals, while 13 hospitals (15%) reported using electrotherapy as required. Twenty-one (25%) hospitals reported routine postoperative use of continuous passive motion (CPM). Patella mobilization techniques were used by 15 (18%) hospitals, while foot and ankle exercises were prescribed by 80 (95%) hospitals. All of the surveyed hospitals reported incorporating physiotherapist-directed patient education routinely as part of postoperative treatment.

Discharge

Most surveyed hospitals (68%) permitted patients to ambulate bearing full weight ($n = 5$; 6%) or bearing weight as tolerated ($n = 52$; 62%) following ACL reconstruction prior to discharge. Protected weight-bearing status (non-, touch or partial weight-bearing) was only enforced by 30% of hospitals surveyed (Figure 2). There was no response to the weight-bearing status on discharge from two hospitals (2%). The expected range of knee flexion on discharge is presented in Figure 3.

With regard to extension range of movement on discharge, 50 hospitals reported 0° was expected of patients, while eight hospitals reported expecting full or terminal extension. Four hospitals stated that no specific range was desired of patients prior to discharge. There was no answer from eight hospitals. In the remaining 14 hospitals, six reported -10°, three reported 10°, three reported 0°–10°, one hospital reported expecting -10°–0° and one reported -15°.

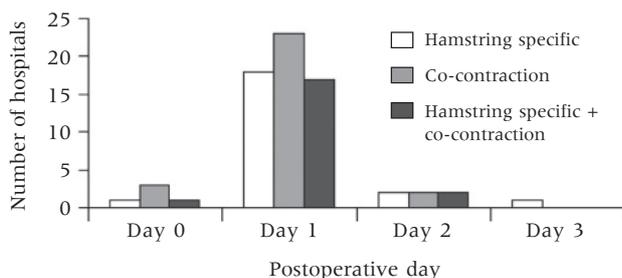


Figure 1. Day of commencement of hamstring exercises. Day 0 = day of operation.

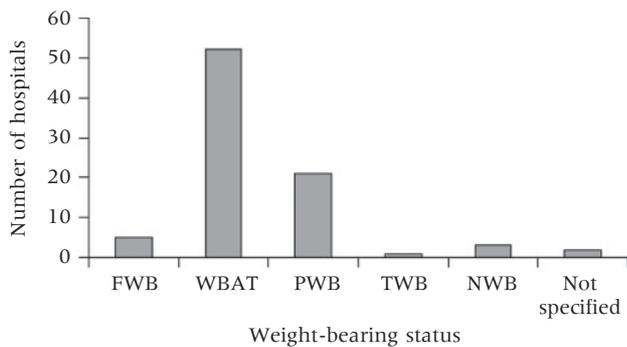


Figure 2. Expected weight-bearing status on discharge from hospital following anterior cruciate ligament reconstruction. FWB = full weight bearing; WBAT = weight bearing as tolerated; PWB = partial weight bearing; TWB = touch weight bearing; NWB = non-weight-bearing.

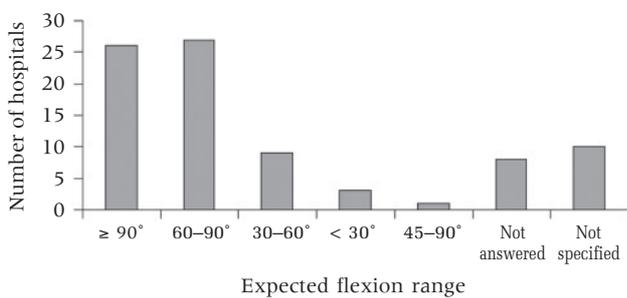


Figure 3. Expected knee flexion range on discharge from hospital following anterior cruciate ligament reconstruction.

The expected number of physiotherapy visits for the first 4 days (inclusive of the day of operation) are depicted in Figure 4. Many responses included a range of 1-2 or 2-3 visits, rather than discrete numbers 1, 2, or 3. It should, therefore, be noted that one visit includes 1 and 1-2 visits, and two visits includes 2 and 2-3 visits.

When hospitals were asked to indicate the expected length of stay following ACL reconstruction, most reported discharging patients by postoperative day 3 (Figure 5). Two hospitals failed to respond to this question.

The most frequently reported criteria for discharge from physiotherapy and from hospital are presented in the Table.

Discussion

There appears to be a paucity of prospective studies investigating acute physiotherapy management following ACL reconstruction compared to the abundance of papers dedicated to the rehabilitation phase. A previous survey of an Australian population by Ng identified that 81% of centres followed a standard protocol after ACL reconstruction, though it was unclear whether this included both the acute and rehabilitative phases of recov-

ery (GYF Ng, PhD, unpublished data, 1995). Eight years on, the current study has identified that 88% of hospitals currently managing ACL reconstructions have a defined protocol for management during the acute postoperative phase.

Overall, it appears that the commonest management strategies following ACL reconstruction are to commence exercise on the day of, or the day following, surgery (quadriceps and hamstrings, bed exercises) with discharge on the second or third day following surgery, using weight bearing as tolerated. Very few, if any, additional modalities are routinely prescribed. In the current study, all patients were given some form of quadriceps exercises, with 91% of respondents indicating the inclusion of static quadriceps contraction. That only half of the respondents included SLR may reflect the lack of consensus about the safety of this exercise. Wessel suggests that the early introduction of SLR when there is a lack of controlled terminal knee extension may impose excessive ACL graft strain [15], whereas Irrgang and Harner suggest that SLR can be included when a quadriceps lag is no longer apparent [3]. Less than one-third of respondents advocated the inclusion of IRQ, and this may reflect the growing concern for excessive strain to be exerted on the graft through lower-leg leverage during knee extension [16].

The inclusion of hamstring exercises is a common practice after ACL reconstruction. While previous stud-

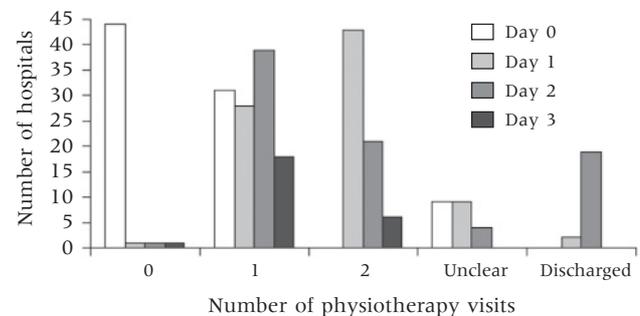


Figure 4. Expected number of physiotherapy visits from Day 0 to postoperative Day 3. Day 0 = day of operation.

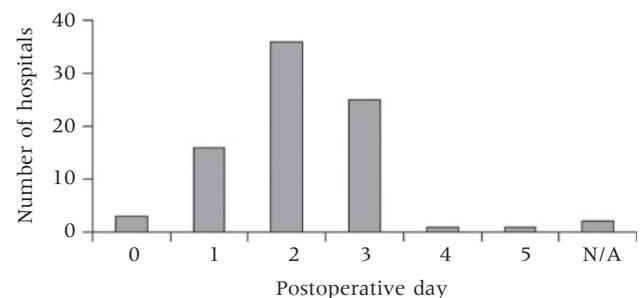


Figure 5. Expected length of hospital stay following anterior cruciate ligament reconstruction. Day 0 = day of operation. N/A = not applicable.

Table. Criteria for discharge from physiotherapy treatment and hospital (N = 84)

Discharge from physiotherapy	Hospitals, n (%)	Discharge from hospital	Hospitals, n (%)
Safe and independent mobility	66 (79)	Safe and independent mobility	56 (67)
Competent performance of exercises for home programme	32 (38)	Adequate pain control	30 (36)
Safe mobility on stairs	28 (33)	Safe and independent mobility on stairs	17 (20)
Adequate pain control	15 (18)	Wound intact	17 (20)
Quadriceps control/no lag	15 (18)	Medically discharged	15 (18)
90° of passive knee flexion	14 (17)	Outpatient appointments made	12 (14)
Full passive terminal extension	12 (14)	Afebrile	12 (14)

ies have reported the inclusion of hamstring exercises, either as a specific exercise or as a co-contraction, it appears that hamstring exercises are now incorporated much earlier within postoperative ACL care. For example, throughout the 1980s, the use of “simultaneous” quadriceps/hamstring exercises (presumably co-contractions) was reported [7], though the stage when these were introduced into postoperative rehabilitation is unclear. Within a decade, McCarthy et al indicated that 60% of patients used co-contractions by the fifth postoperative day and 74% commenced local hamstring exercises by the second postoperative week [4]. In contrast to these findings, the current study indicated that 61% of hospitals prescribed some form of hamstring exercise and 88% commenced the exercise on the day of the operation or the following day.

Most protocols recommended in the literature include information about the expected ranges of movement to be achieved prior to discharge [17–19]. While previous studies provide general information about expectations of flexion range, expectations for extension range have not previously been clearly reported. The importance of regaining full extension early in the postoperative period is well recognized, to avoid the complications of immobilization including flexion contractures, anterior knee pain, abnormal patellofemoral alignment and altered graft position in the intercondylar notch [3,6,19,20]. In the current study, almost two-thirds of respondents aimed for approximately 90° of flexion and full or end-of-range extension on discharge.

The use of braces in the current study was lower than previously reported. Bilko et al found that 64% of respondents recommended a brace for return to full activity [7], McCarthy et al reported that 80% of respondents prescribed a brace for 2 weeks to 6 months [4], and Lai and Ng indicated that up to 68% of respondents recommended the use of a brace following ACL reconstruction [14]. Current reviews of high-level research designs investigating the efficacy of bracing after ACL reconstruction have produced inconclusive results, as both the Cochrane Library and PEDro database suggest

that there is insufficient evidence to either completely discard or promote brace use [9,21–24].

The inclusion of cryotherapy into management protocols post-ACL reconstruction does not appear to have been specifically investigated by previous comprehensive studies. In the current study, clinicians appeared to be divided over the use of cryotherapy, with 42% using it routinely and 58% reporting occasional use only. A number of comparative studies suggest that application of ice affords no additional benefits for length of hospitalization, knee drainage, analgesia use, subjective pain and range of movement [25–28].

The use of electrotherapy and CPM were the least commonly reported of adjunctive modalities (1% and 25%, respectively). Despite electrotherapy’s potential benefits for pain relief and muscle re-education [29,30], only one paper could be identified which specifically investigated the use of electrotherapy (electrical stimulation and biofeedback) following ACL reconstruction [31], whereas a number of studies exist concerning the use of CPM in this clientele. The use of CPM in the current study was much less than reported in previous studies (25% vs 34% [7], 37% [4] and 54% [14]). A review of the currently available randomized controlled trials concerning the use of CPM during postoperative management of ACL reconstruction suggests that while no deleterious effects on joint laxity are apparent at 1 year [32], most studies could not establish significant improvements in joint swelling, muscle atrophy, range of movement and joint stability [10,23,33]. While there may be potential benefits of modalities such as CPM and electrotherapy, these benefits may be outweighed by the time and cost associated with their inclusion within postoperative management. Alternatively, the decline in the use of CPM and the lack of electrotherapy use in this group may reflect increased awareness of the need for strong supporting evidence.

There is sufficient evidence in the literature to reinforce the safety of full weight bearing (or weight bearing as tolerated) immediately following ACL reconstruction [6,11,18,19]. During the past decade, there appears to

have been a move towards a less conservative approach to weight bearing. Patients are rapidly progressed towards full weight bearing or weight bearing as tolerated, compared with a more conservative approach of partial, touch or non-weight bearing. This is clearly evident in the current study, where most patients (68%) were weight bearing in an unprotected manner on discharge as early as postoperative day 2 or 3. This is comparable with the report of McCarthy et al [4], where 63% of patients were partial weight bearing by postoperative day 2, and of Bilko et al [7], where the expected return to full weight bearing varied from 3 to 16 weeks.

In agreement with recommendations in the literature [34–36], most hospitals surveyed in the current study expected patients to be discharged on postoperative day 2 (44%). It is interesting to note that the more recent observations of a trend toward day surgery has not been reflected in this study, in that only 1% of hospitals surveyed expected the patient to be discharged on day 0.

A wide variety of discharge criteria following ACL reconstruction were reported by hospitals surveyed in the current study, in addition to those reported in the Table. Most of these additional criteria constituted a more specific aspect of those included in the main list, rather than being distinctly different, for example, exercise handouts given, drains removed and clearance by all health disciplines. Of note, in 27 responses (32%), the criteria for discharge from hospital were reported as being the same as the criteria for discharge from physiotherapy. There may be a relationship between this finding and the fact that in 71% of cases, the physiotherapist, alone or in conjunction with the surgeon, was reported to be involved in the development of the protocol. This may reflect the clear interdependence of physiotherapy and medical management in the period to discharge.

While every effort was made when designing the current study to maximize the reliability and validity of the data collection and reporting using a rigorous study design, the authors recognize that the study may have had a number of limitations. There may have been confusion about terminology relating to the day of surgery being classified as day 0 rather than day 1. There was also an assumption that the terms “electrotherapy”, “IRQ”, “SLR” and “static quads” were generic terms that all physiotherapists would interpret universally as specific interventions/exercises. In the hospitals surveyed in this study, a range of ACL reconstructions were performed. The results do not differentiate the early management practices for those hospitals where large or small numbers of reconstructions were supervised.

Conclusions

This study found that management practices in the acute phase following ACL reconstruction varied considerably

throughout Australia and there is no standardized Australian inpatient management protocol. Although there is wide variation in the types of quadriceps exercises used, there appears to be confidence in the safe commencement of static quadriceps contraction and equivocal use of SLR exercises. Of concern are the relatively high numbers reportedly prescribing IRQ. There are indications of a strong awareness among Australian physiotherapists of the importance of hamstring exercises and quadriceps/hamstring co-contraction exercises in the early postoperative management period. These exercises for hamstrings appear to be introduced earlier than has been reported in previous studies. Enthusiastic support for the use of CPM, bracing, cryotherapy and electrotherapy was not found. There appears to be an expectation of an earlier return to full weight bearing in the past decade. Most patients are discharged on postoperative day 2, when ambulation is independent and there is unprotected weight bearing. There is an expectation at discharge of up to 90° of knee flexion range and 0° of extension. Overall, the findings of this study suggest that clinicians support a less conservative approach to early postoperative management following ACL reconstruction than has previously been reported. It would be interesting to repeat the survey in 5 or so years to measure the influence of the apparent growth in day surgery for ACL reconstructions. One could also argue that the practice diversity found in this study may reflect a growing awareness of the need to include only early management strategies that are grounded in evidence.

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