

[Physical Therapy]

Rehabilitation Charges Associated With Anterior Cruciate Ligament Reconstruction

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Background: Pre- and postoperative rehabilitation are important to the management of patients with anterior cruciate ligament (ACL) reconstruction, but little attention has been given to the costs. This study evaluated the pre- and postoperative rehabilitation charges in patients with ACL reconstruction in the United States.

Hypothesis: Patients receive preoperative rehabilitation less commonly than postoperative rehabilitation.

Study Design: Retrospective database study.

Level of Evidence: Level 4.

Methods: Using the PearlDiver database, we identified patients undergoing ACL reconstruction from 2007 through 2011 using Current Procedural Terminology codes. The associated rehabilitation charges billed to insurance providers for 90 days preoperatively and 6 months postoperatively were categorized as physical therapy or as durable medical equipment (DME). The charges were examined by year and geographic region and represented as per-patient average charges (PPACs).

Results: A total of 92,179 patients were identified in the study period. The PPAC for rehabilitation was \$241 during the 90-day preoperative period and \$1876 for the 6-month postoperative period. Patients averaged 2 preoperative sessions for physical therapy, with 44% of patients receiving preoperative rehabilitation in contrast with an average of 17 postoperative sessions per patient in 93% of patients. Rehabilitation charges were greater postoperatively than preoperatively ($P < 0.05$). Preoperatively, 24% of patients received a DME, while 35% received a DME postoperatively. Preoperative rehabilitation PPACs were highest in the Northeast, followed by Midwest, South, and West ($P < 0.05$). There were no significant differences in postoperative rehabilitation PPACs for geographic region ($P = 0.43$).

Conclusion: Preoperative rehabilitation charges were lower than postoperative charges. A patient undergoing ACL reconstruction typically received 9 times more sessions of postoperative physical therapy than preoperative.

Clinical Relevance: This study found that preoperative supervised rehabilitation for patients with ACL reconstruction was infrequent across the United States.

Keywords: anterior cruciate ligament reconstruction; rehabilitation; physical therapy; durable medical equipment; charges

Although the exact incidence of anterior cruciate ligament (ACL) injuries is unknown, nearly 200,000 ACL reconstructions are performed each year in the United States.^{3,6,16} Postoperative rehabilitation is a necessary part of the

treatment for optimal results.^{10,14} A most recent systematic review reported little to no evidence of any patient benefit to bracing or continuous passive motion device usage after ACL reconstruction and that home-based and in-clinic physical

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therapy attain equal levels of effectiveness.¹¹ With regard to specific rehabilitation programs involving neuromuscular electrical stimulation, accelerated rehabilitation, or delayed programs, additional studies are warranted.¹¹ In addition to postoperative rehabilitation, several recent studies have also indicated a role for preoperative rehabilitation that may improve postoperative return to activity or long-term outcomes due to favorable effects on quadriceps strength.^{2,7,9,15}

Prior to ACL reconstruction, preoperative rehabilitation sessions could potentially contribute significant additional charges due to both the sessions that are directly billed and the opportunities lost through missed work or school. Previous studies have examined the benefits of both preoperative and postoperative rehabilitation programs^{5,7,8,10,14,15} and the overall economic burden of ACL reconstruction¹² compared with nonoperative management. The purpose of this study was to use available data to examine the charges for pre- and postoperative rehabilitation including charges for durable medical equipment (DME) in patients undergoing ACL reconstruction.

METHODS

A retrospective review of the PearlDiver Patient Record Database (PearlDiver) was conducted for the years 2007 through 2011. PearlDiver is a commercially available insurance company database with Health Insurance Portability and Accountability Act (HIPAA)-compliant patient data from UnitedHealthcare on more than 21 million orthopaedic patients. A search was performed for all associated nonsurgical Current Procedural Terminology (CPT) codes for the cohort of patients who were identified in the 90-day period before undergoing ACL reconstruction and in the 6-month period postreconstruction (see the Appendix, available at <http://sph.sagepub.com/content/by/supplemental-data>). Physical therapy and durable medical equipment (DME) codes as well as the associated charges reported for 1% of patients or more were recorded for these time periods. The codes for 1% of patients or more were used in this analysis because these likely represented the most common rehabilitation codes in the perioperative period surrounding ACL reconstruction, as has been done in other similar studies.^{1,18} Total charges billed to insurance providers for physical therapy and DME and the percentages they composed of the total overall charges were recorded. The data were additionally stratified on a per-year basis and by geographic region (Northeast, Midwest, South, and West). Per-patient average charges (PPACs) were calculated by dividing the charges by the total number of ACL reconstruction patients. Per-year charges were adjusted for inflation to 2011 US dollars using the Consumer Price Index (CPI) provided by the US Bureau of Labor Statistics. Statistically, the Tukey honestly significant difference (HSD) test was used to determine statistical significance of PPACs with regard to geographic region and yearly comparisons. Significant differences were concluded when $P < 0.05$.

RESULTS

Over the 2007 to 2011 study period, a total of 92,179 patients underwent ACL reconstruction (CPT codes, 27428 and 29888). For these patients, 40 unique CPT codes for rehabilitation were searched to extract charges (see the Appendix).

Over the 5-year study period, the 90-day preoperative rehabilitation PPAC was \$241. Rehabilitation PPACs did not vary significantly between years in the preoperative period ($P = 0.69$). The preoperative physical therapy PPAC was \$154, or 64% of total preoperative rehabilitation charges. By contrast, preoperative DME had a PPAC of \$87, or 36% of total preoperative rehabilitation charges. On average, physical therapy was coded 2 times per patient in the preoperative period while DMEs were coded at an average rate of 0.2 times per patient. Preoperatively, 44% of ACL reconstruction patients received physical therapy while 24% received some type of DME.

The 6-month postoperative rehabilitation PPAC was \$1876, and differences in PPAC between years were not significant ($P = 0.94$). Physical therapy PPAC was \$1704 or 91% of total postoperative rehabilitation charges, and the PPAC for DME was \$172, which was 9% of total postoperative rehabilitation charges. Codes specific to physical therapy were recorded an average of 17 times per patient, while DME codes were recorded an average of 0.4 times per patient. Of all ACL reconstruction patients, 93% received some form of physical therapy, while 35% received a DME. The PPAC for postoperative rehabilitation was significantly larger than that for preoperative rehabilitation ($P < 0.05$) (Table 1). Table 2 gives the range of physical therapy and DME PPACs in both the pre- and postoperative time periods.

When ACL reconstruction codes were categorized by US geographic region, 43% of ACL reconstruction patients were located in the South, 24% in the Midwest, 21% in the West, and 12% in the Northeast. The PPACs for preoperative rehabilitation according to geographic region were \$356 in the Northeast, \$219 in the Midwest, \$198 in the South, and \$166 in the West (Figure 1). Preoperative rehabilitation PPAC was significantly greater for the Northeast than for any other region ($P < 0.05$ for all comparisons). Preoperative rehabilitation PPAC was significantly greater for the Midwest than for the South or West ($P < 0.001$ for Midwest vs South, $P = 0.05$ for Midwest vs West). Preoperative rehabilitation PPAC was significantly greater for the South than for the West ($P < 0.05$).

The PPAC for postoperative rehabilitation according to geographic region was \$2430 in the Northeast, \$1960 in the Midwest, \$1799 in the South, and \$1527 in the West; however, none of these differences was significant ($P = 0.43$) (Figure 2). In addition, the billing charges for a single session of physical therapy was \$85 in the Northeast, \$92 in the Midwest, \$91 in the South, and \$77 in the West. The variation among these charges was not significant ($P = 0.55$).

Table 1. Per-patient average charge (PPAC) and percentage of total charges for preoperative and postoperative rehabilitation categories^a

Category	PPAC, \$	% of Total Rehabilitation Charges Billed to Insurance Providers
90-day preoperative period		
Physical therapy	154	64
Durable medical equipment	87	36
Preoperative rehabilitation total	241	
6-month postoperative period		
Physical therapy	1704	91
Durable medical equipment	172	9
Postoperative rehabilitation total	1876	

^aPhysical therapy represents the majority of rehabilitation charges billed to insurance providers in both preoperative and postoperative periods, and overall postoperative rehabilitation PPAC is higher than preoperative PPAC ($P < 0.05$).

Table 2. Descriptive statistics

	Preoperative Physical Therapy	Preoperative DME	Postoperative Physical Therapy	Postoperative DME
Minimum charge, \$	92	78	57	95
Maximum charge, \$	784	1316	4079	1458
Standard deviation, \$	170	399	768	528
Overall PPAC, \$	154	87	1704	172

DME, durable medical equipment; PPAC, per-patient average charge.

DISCUSSION

While surgery is not always indicated for ACL injury, rehabilitation is an essential part in the management of these injuries.^{2,4,5,8-10,13-15,17} Grindem et al⁷ compared knee function both preoperatively and 2 years post-ACL reconstruction between patients who underwent preoperative and postoperative rehabilitation and patient data from those in the Norwegian National Knee Ligament Registry that did not undergo preoperative rehabilitation. Patients in the preoperative rehabilitation program were given the goal of regaining 90% quadriceps and hamstring strength in addition to hopping performance before undergoing ACL reconstruction.⁷ Patients that underwent the combined rehabilitation program showed significantly superior patient-reported outcomes at 2 years postoperatively compared with those who underwent only postoperative rehabilitation.⁷

Limitations

There are a number of limitations within this study that result from the use of the PearlDiver database. The quality of the data available for our analysis depends on the quality of the input data. Thus, some revision ACL reconstructions may have been included in our data. Additionally, the database lacks clinical outcome data, and as a result, we cannot draw any conclusions regarding the efficacy of the reported rehabilitation management. Also, the database reports charges billed to insurance providers rather than actual reimbursement (ie, costs). However, because reimbursement is typically a proportion of the submitted charge, our data are likely valid as an overall representation of the distribution of costs. Furthermore, the database compiles data submitted from a single private insurance company, UnitedHealthcare, and does not provide Medicaid or Medicare data, which limits the scope of coverage

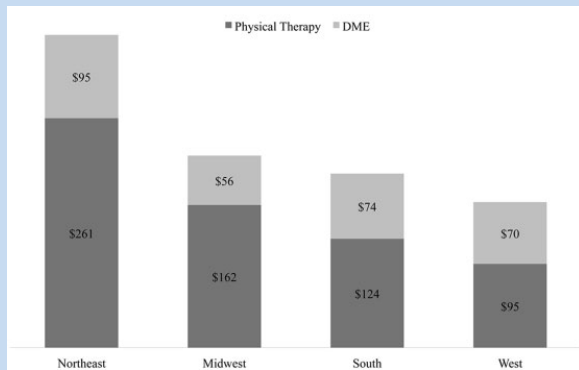


Figure 1. Preoperative rehabilitation per-patient average charges (PPACs) stratified by geographic region and statistical analysis. PPACs for physical therapy sessions and durable medical equipment (DME) are presented for the 90-day preoperative period before anterior cruciate ligament (ACL) reconstruction. Preoperative rehabilitation PPAC was significantly greater for the Northeast than for any other region ($P < 0.05$), significantly greater for the Midwest than for the South or West ($P \leq 0.05$ for South and West), and significantly greater for the South than for the West ($P < 0.05$).

across the nation and could generate potential selection bias. The large number of patients in this study provides power to our analysis and is likely a representative sample of ACL reconstruction patients in the United States.

CONCLUSION

This study found that preoperative supervised rehabilitation for ACL reconstruction patients was infrequent across the United States, with higher per-patient average charges billed to insurance providers in the Northeast for physical therapy.

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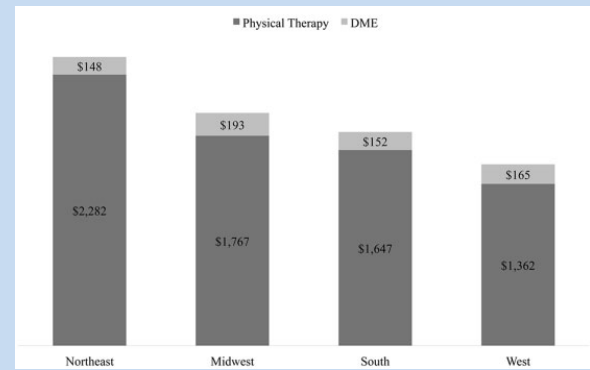


Figure 2. Postoperative rehabilitation per-patient average charges (PPACs) stratified by geographic region and statistical analysis. PPACs for physical therapy sessions and durable medical equipment (DME) are presented for the 6-month postoperative period after anterior cruciate ligament (ACL) reconstruction. Postoperative PPACs were not significantly different by region ($P = 0.43$).

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