Purpose: To provide a synthesis of the highest-quality literature available comparing early passive motion (EPM) with strict sling immobilization during the first 4 to 6 weeks after surgery. Methods: The Medline, Cochrane, and Embase databases were searched for eligible studies. We reviewed 886 citations, and 5 randomized clinical trials (RCTs) (Level II) met the inclusion criteria for meta-analysis. Four RCTs contributed to the analysis of range of motion, and 5 contributed to the analysis of ret reat rates. A single Level IV study was available for qualitative review. Random-effects models were used for meta-analysis, computing mean differences for continuous variables and risk ratios for dichotomous variables.

Results: EPM resulted in improved shoulder forward flexion at 3 months (mean difference, 14.70; 95% confidence interval [CI], 10.43 to 19.97; P = .0006). Rotator cuff retear rates (16.3% for immobilization vs 21.1% for EPM; risk ratio, 0.82; 95% CI, 0.57 to 1.20; P = .31) were not significantly different between EPM and immobilization at a minimum of 1 year of follow-up. Conclusions: A small number of RCTs with low to moderate risks of bias are currently available. Meta-analysis suggests that after primary arthroscopic rotator cuff repair of small to medium tears, EPM results in 15° of improved forward flexion at 3 months and approximately 5° at 6 and 12 months. External rotation is improved by 10° with EPM at 3 months only. The clinical importance of these differences has yet to be determined. Retreat rates at a minimum of 1 year of follow-up are not clearly affected by type of rehabilitation.

Level of Evidence: Level II, meta-analysis of Level II studies and qualitative review of Level IV study.

Arthroscopic rotator cuff repair is a cost-effective intervention with a documented ability to reduce pain and improve functional outcome scores, despite retear rates varying from 25% to 90% depending on tear size and repair technique. Although stiffness is less common than after open repair, it remains the most frequent complication of arthroscopic rotator cuff surgery. Shoulder stiffness can be a source of pain, functional limitation, and frustration for patients. Several risk factors for stiffness after arthroscopic rotator cuff repair have been identified, including preoperative stiffness; Workers’ Compensation insurance; age younger than 50 years; partial articular-sided tears; and coexisting adhesive capsulitis, calcific tendonitis, or labral pathology.

The influence of early passive motion (EPM)—or sling immobilization—on postsurgical stiffness is still a source of considerable debate. The question is of particular interest because, unlike other risk factors, it is directly under the surgeon’s control. A 2009 systematic review found insufficient evidence to provide any evidence-based recommendations for rotator cuff rehabilitation and protection protocols. More recently, an evidence-based rehabilitation protocol has been proposed, in which patients were stratified based on age, tear size, tissue quality, and security of repair. “High-risk” patients had passive range-of-motion (PROM) restrictions for 2 to 4 weeks, whereas “low-risk” patients started PROM the day after surgery. These recommendations were based on the authors’ opinion and informal synthesis of the basic science and clinical literature (Level V data).

In the past 2 years, 5 randomized clinical trials (RCTs) have been published comparing EPM and sling immobilization after arthroscopic rotator cuff repair. The purpose of this meta-analysis is to provide a synthesis of the highest-quality literature available comparing EPM with strict sling immobilization during the first 4 to 6
weeks after surgery. The null hypothesis is that EPM and sling immobilization result in equivalent range of motion and rotator cuff retear rates.

**Methods**

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to structure this review. The detailed guidelines can be found at www.prisma-statement.org.

For the qualitative portion of the review, all studies published in peer-reviewed journals comparing the effects of immobilization and EPM after rotator cuff repair were considered. Clinical studies of all designs (Level I to IV) were considered eligible.

For the quantitative meta-analysis, only RCTs published in peer-reviewed journals were considered. Study eligibility criteria included arthroscopic rotator cuff repair as the index procedure, randomization to EPM versus immobilization, minimum of 1 year of follow-up, and reporting of appropriate statistical measures.

The PubMed, Cochrane, and Embase online databases were reviewed for all English-language studies published before February 1, 2014, at which time our final literature search was performed. No articles published before 1981 were identified.

The aforementioned databases were searched using the key phrases shown in Table 1. All abstracts were reviewed in duplicate by the study authors and assessed for eligibility. The full text of eligible studies was then reviewed by the same authors before final inclusion in the systematic review. The primary outcome of our study was rotator cuff retear rate, and the secondary outcome was range of motion. If 3 or more RCTs measured the primary and/or secondary outcomes, they were considered for meta-analysis.

Data were extracted in duplicate from all studies using a standardized form created by the authors at the onset of the review. Any inconsistencies between reviewers were resolved by joint review of the involved studies.

All outcome variables reported in the literature were included in our data extraction sheet. When possible, quantitative meta-analysis of clinical studies was performed. For continuous outcomes, the summary measure was the difference in means. For dichotomous outcomes, the summary measure was the risk ratio.

All studies included in the meta-analysis were reviewed in duplicate for quality of design and risk of bias using the standardized Cochrane Database questionnaire (www.cochrane.org).

Heterogeneity was assessed by comparing study designs, interventions, and outcomes. In addition, statistical tests of heterogeneity ($\tau^2$, $\chi^2$, and $I^2$) were calculated. $I^2$ greater than 75% was used as a cutoff for pooling of data because this is the classically described threshold for a “high” level of heterogeneity. $^1$ Given the observed heterogeneity, random-effects models based on inverse variance were used for meta-analysis of continuous variables. Random-effects Mantel-Haenszel models were used for dichotomous variables. All statistical analyses were performed with Review Manager (RevMan, version 5.1; Nordic Cochrane Centre/Cochrane Collaboration, Copenhagen, Denmark). Statistical significance was defined as $P < .05$.

A random-effects model was chosen for meta-analysis because this is generally (though not always) the more...
### Table 2. Characteristics of Studies Included in Meta-Analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients</th>
<th>Mean Age (yr)</th>
<th>Age Range (yr)</th>
<th>Tear Size (cm)</th>
<th>Initiation of PT in Early-Motion Group (Days After Surgery)</th>
<th>Frequency of PT in Early-Motion Group (Sessions/Week)</th>
<th>Protocol in Early-Motion Group</th>
<th>Protocol in Immobilization Group</th>
<th>Duration of Sling Immobilization in Control Group (wk)</th>
<th>Immobilizer Type</th>
<th>Outcomes Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arndt et al., 12</td>
<td>92</td>
<td>55.3</td>
<td>37-71</td>
<td>NA (only non-retracted, single-tendon tears included)</td>
<td>1</td>
<td>3-5</td>
<td>Pendulums, manual passive ROM, CPM, no limitations</td>
<td>Pendulums, hand/elbow/wrist ROM</td>
<td>6</td>
<td>Sling</td>
<td>ROM, Constant score, healing on CT arthrogram</td>
</tr>
<tr>
<td>Cuff and Pupello, 13</td>
<td>68</td>
<td>63.2</td>
<td>19-76</td>
<td>NA (excluded L-shaped tears and tears large enough to require margin convergence)</td>
<td>2</td>
<td>3</td>
<td>Pendulums, manual passive ROM, FF &lt;120° and ER &lt;30° for 3 wk</td>
<td>Pendulums, hand/elbow/wrist ROM</td>
<td>6</td>
<td>Shoulder immobilizer</td>
<td>ASES score, SST score, ROM, healing on US</td>
</tr>
<tr>
<td>Keener et al., 16</td>
<td>122</td>
<td>55.3</td>
<td>&lt;65</td>
<td>&lt;3</td>
<td>1</td>
<td>2</td>
<td>Pendulums, manual passive ROM, hand/elbow/wrist ROM</td>
<td>Hand/elbow/wrist ROM</td>
<td>6</td>
<td>Sling</td>
<td>ROM, Constant score, abduction and ER strength, VAS, SST score, ASES score, healing on US</td>
</tr>
<tr>
<td>Kim et al., 14</td>
<td>105</td>
<td>60</td>
<td>27-82</td>
<td>&lt;3</td>
<td>1</td>
<td>NA</td>
<td>Pendulums, manual passive ROM</td>
<td>Shoulder shrugs, hand/elbow/wrist ROM</td>
<td>Small tears (&lt;1 cm), 4; medium tears (1-3 cm), 5</td>
<td>Sling with abduction pillow</td>
<td>ROM, SST score, ASES score, Constant score, healing on CT arthrogram or MRI</td>
</tr>
<tr>
<td>Lee et al., 15</td>
<td>64</td>
<td>54.8</td>
<td>39-66</td>
<td>1-5</td>
<td>1</td>
<td>10</td>
<td>Pendulums, manual passive ROM, ER &lt;30° with CPM, no PT</td>
<td>FF to 90° with CPM, no PT</td>
<td>6</td>
<td>Sling with abduction pillow</td>
<td>ROM, VAS, strength, UCLA score, healing on MRI</td>
</tr>
</tbody>
</table>

ASES, American Shoulder and Elbow Surgeons; CPM, continuous passive motion; CT, computed tomography; ER, external rotation; FF, forward flexion; MRI, magnetic resonance imaging; NA, not available; PT, physical therapy; ROM, range of motion; SST, Simple Shoulder Test; UCLA, University of California, Los Angeles; US, ultrasonography; VAS, visual analog pain score.
conservative model. The effect of the meta-analysis model on our results was assessed by running all calculations using both random- and fixed-effects models. In addition, 1 of the studies included in the meta-analysis had slightly more aggressive rehabilitation protocols in both the EPM and immobilization groups (Table 2). We performed meta-analysis both with and without this study (using random- and fixed-effects models) to assess its effects on the reported results.

### Results

A total of 877 citations were identified from the PubMed, Embase, and Cochrane databases based on our original key phrase searches. Five RCTs met the inclusion criteria for the quantitative meta-analysis. There were insufficient data in 1 of the RCTs to contribute to the analysis of range of motion. Therefore 4 RCTs were used in the analysis of range of motion, and 5 RCTs were used in the analysis of retear rates. A single Level IV study was eligible for qualitative review. A summary of the review process is provided in Fig 1.

#### Non-Randomized Clinical Studies

Huberty et al. evaluated 79 patients considered “at risk” for postoperative stiffness based on previously described criteria were enrolled in a physical therapy program that included early overhead, closed-chain PROM exercises. These patients were compared with historical controls who were strictly immobilized for 6 weeks (Level IV data). Postoperative stiffness was defined by a patient’s self-reported discontent with his or her range of motion rather than a numeric range-of-motion cutoff. In this study none of the 79 patients in the early-motion protocol met the criteria for postoperative stiffness. This was significantly less than the rate of stiffness in the historical control group (7.8%, \( P = .004 \)). Seventy-three patients who had no risk factors for stiffness were treated in a sling for 6 weeks after surgery. Although none of these patients met the criteria for postoperative stiffness, this was not significantly different from the historical rate of stiffness in low-risk patients (2.3%, \( P = .22 \)).

#### Meta-Analysis of RCTs

**Range of Motion.** Five RCTs met the inclusion criteria for our meta-analysis. A summary of the study characteristics is provided in Table 2. Four studies were included in the range-of-motion analysis at 3, 6, and 12 months, representing a total of 375 patients (EPM, \( n = 196 \); immobilization, \( n = 179 \)).

At 3 months, forward flexion (mean difference, 14.70°; 95% confidence interval [CI], 5.52° to 23.87°; \( P = .002 \)) and external rotation at the side (mean difference, 10.43°; 95% CI, 4.51° to 16.34°; \( P = .0006 \)) were significantly better in the EPM group (Fig 2).

At 6 months, forward flexion (mean difference, 4.31°; 95% CI, 0.17° to 8.45°; \( P = .04 \)) was significantly better in the EPM group (Fig 3). There was no significant difference in external rotation (mean difference, 5.14°; 95% CI, −1.02° to 11.31°; \( P = .1 \)) (Fig 3).

At 12 months, forward flexion was significantly better in the EPM group (mean difference, 4.18°; 95% CI, 0.36° to 8.00°; \( P = .03 \)) whereas there was no difference in external rotation at the side between groups (mean difference, 2.66°; 95% CI, −3.84° to 9.17°; \( P = .42 \)) (Fig 4).

**Rettear Rate at Final Follow-Up.** Five studies were included in the analysis of retear rate, representing a total of 445 patients (EPM, \( n = 231 \); immobilization, \( n = 214 \)). A minimum of 12 months’ follow-up

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**Fig 2.** Range of motion (in degrees) at 3 months after surgery. (A) EPM results in improved forward flexion. (B) EPM results in improved external rotation at the side. Meta-analysis results are shown for the 4 included studies. Data are reported as mean differences between the EPM and immobilization groups with 95% CIs. A positive mean difference indicates superiority of the EPM group. The size of each box is proportional to the study weight in the meta-analysis. The bars on either side of the boxes represent the 95% CI. (IV, inverse variance; Random, random-effects model.)

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<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Early Passive Motion</th>
<th>Immobilization</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean SD Total</td>
<td>Mean SD Total</td>
<td>IV, Random, 95% CI</td>
<td>IV, Random, 95% CI</td>
</tr>
<tr>
<td>Arnlov 2012</td>
<td>142.1 28.2 49</td>
<td>112.8 37.6 43</td>
<td>25.8% 13.00 [2.85, 23.15]</td>
<td>23.20 [15.47, 32.93]</td>
</tr>
<tr>
<td>Keener 2014</td>
<td>136 23.6 61</td>
<td>123 30.6 53</td>
<td>25.8% 14.66 [1.59, 17.73]</td>
<td>8.86 [1.79, 15.93]</td>
</tr>
<tr>
<td>Kim 2012</td>
<td>144.6 18.2 56</td>
<td>140 24.7 49</td>
<td>25.8% 13.39 [1.27, 15.51]</td>
<td>8.86 [1.79, 15.93]</td>
</tr>
<tr>
<td>Lee 2012</td>
<td>140.7 12.7 30</td>
<td>133.8 27.4 34</td>
<td>25.8% 15.90 [5.53, 26.17]</td>
<td>8.86 [1.79, 15.93]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>196</td>
<td>179</td>
<td>100.0% 14.70 (5.52, 23.87)</td>
<td>8.86 (1.79, 15.93)</td>
</tr>
</tbody>
</table>

Heterogeneity: \( T^2 = 58.81; I^2 = 93.88; df = 3 \) (\( P = 0.02; I^2 = 68 \)). Test for overall effect: \( Z = 3.14 (P = 0.002) \).
was available for all patients. There was no statistically significant difference in rotator cuff retear rates between the immobilization and EPM groups (16.3% for immobilization vs 21.1% for EPM; risk ratio, 0.82; 95% CI, 0.57 to 1.20; \( P = .31 \)) (Fig 5). However, the narrow CI and low heterogeneity (\( I^2 = 0% \)) suggest that with a larger number of studies, a clinically and statistically significant increase in retears with EPM might be identified.

**Methodologic Quality of Included RCTs.** A standardized risk of bias assessment of the 5 included RCTs is provided in Fig 6. In brief, the study by Arnldt et al.\(^\text{12}\) has significant weaknesses. They did not describe their randomization technique, there was no obvious allocation concealment, the participants and surgeons were not blinded, and it is unclear whether the treating surgeons or blinded evaluators performed the outcome assessments. They did, however, have a high study retention rate. The study by Cuff et al.\(^\text{13}\) used more sound methodology. They used an appropriate randomization technique, and allocations were appropriately concealed until after surgery. Blinded assessors performed outcome assessments in triplicate. The major shortcoming of this trial was the incomplete reporting of statistical data that precluded inclusion in 3 of our 4 meta-analyses. The authors were contacted, but no further data were available. Kim et al.\(^\text{14}\) used an appropriate randomization technique; however, allocations were not concealed, and the treating surgeons who were not blinded to the rehabilitation protocol performed outcome assessments. In the study by Lee et al.\(^\text{15}\) the details of randomization were not provided. Although appropriate allocation concealment was performed, the treating surgeon who

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**Fig 3.** Range of motion (in degrees) at 6 months after surgery. (A) EPM results in improved forward flexion. (B) EPM and immobilization result in statistically equivalent external rotation at the side. Meta-analysis results are shown for the 4 included studies. Data are reported as mean differences between the EPM and immobilization groups with 95% CIs. A positive mean difference indicates superiority of the EPM group. The size of each box is proportional to the study weight in the meta-analysis. The bars on either side of the boxes represent the 95% CI. (IV, inverse variance; Random, random-effects model.)

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**Fig 4.** Range of motion (in degrees) at 12 months after surgery. (A) EPM results in improved forward flexion. (B) External rotation at the side is no different between the EPM and immobilization groups. Meta-analysis results are shown for the 4 included studies. Data are reported as mean differences between the EPM and immobilization groups with 95% CIs. A positive mean difference indicates superiority of the EPM group. The size of each box is proportional to the study weight in the meta-analysis. The bars on either side of the boxes represent the 95% CI. (IV, inverse variance; Random, random-effects model.)
was not blinded to therapy protocol performed all outcome assessments. In addition, a significant number of patients refused to undergo postoperative magnetic resonance imaging to assess rotator cuff healing, posing a high risk of attrition bias. Finally, the study by Keener et al.\textsuperscript{16} should be commended for using appropriate risk of attrition bias. This effect dampens with time, and differences of approximately 5° in favor of EPM persist at 1 year. External rotation was improved with EPM only at 3 months. At a minimum of 1 year of follow-up, there were no statistically significant differences in rotator cuff retear rates with EPM or sling immobilization.

Results of individual animal studies or non-randomized studies are often quoted to support conflicting immobilization protocols.\textsuperscript{11,20,21} The meta-analysis performed in this study, though limited by the small number of available RCTs, provides reasonable evidence that EPM results in improved shoulder forward flexion and external rotation at the side. The magnitude of these differences was 10° to 15° at 3 months, 5° to 10° at 6 months, and approximately 5° at 1 year. The impact of these findings on surgical practice is somewhat difficult to infer. It has been shown that patients have individual—and variable—thresholds at which stiffness becomes a functional impairment.\textsuperscript{19} As a result, there is no consensus as to the smallest clinically significant difference in range of motion. In addition, EPM is usually performed under the supervision of a physical therapist. There is concern that the risk of retear is higher with home exercises, in that rotator cuff muscle activation is increased.\textsuperscript{22-24} Unfortunately, no data on return to work, sick leave, narcotic use, disability/Workers’ Compensation claims, and the perceived utility of the improved motion by patients will be necessary to answer this adequately.

The second important conclusion of this meta-analysis is that EPM and sling immobilization have statistically equivalent retear rates at a minimum of 1 year of follow-up. The primary argument against EPM has been concern over rupture of the healing tendon and the effects this might have on outcomes.\textsuperscript{11,13,20} The available RCTs do not provide conclusive evidence that EPM and sling immobilization have identical safety profiles. However, with the best data available at the time of our review, the use of EPM appears to be a safe option. An important question not answered by our meta-analysis is whether EPM should be supervised by a physical therapist. There is concern that the risk of retear is higher with home exercises, in that rotator cuff muscle activation is increased.\textsuperscript{22-24} Unfortunately, no studies have compared rotator cuff retear rates between the 2 types of rehabilitation.\textsuperscript{10} These data will be important in determining the safest and most cost-effective rehabilitation protocol.

Sensitivity analysis helped confirm the validity of our findings. The conclusions of the meta-analysis were not significantly affected by the type of model used or by inclusion of the study with slightly more aggressive rehabilitation protocols\textsuperscript{13} than the other 3 studies. Excluding the study by Lee et al.\textsuperscript{15} and using a random-effects model produced the most conservative results, whereas using a fixed-effects model and including all

\begin{table}[!h]
\centering
\begin{tabular}{|l|c|c|c|c|c|}
\hline
Study or Subgroup & Immobilization & Early Passive Motion & Risk Ratio & Risk Ratio \\
& Events Total & Events Total & M-H, Random, 95% CI & M-H, Random, 95% CI \\
\hline
Amidi 2012 & 16 22 & 4 5 & 22 & 49 56.9% & 0.83 (0.50, 1.36) \\
Cuff 2012 & 4 5 & 33 9.4% & 0.75 (0.22, 2.57) \\
Keener 2014 & 3 6 & 63 7.8% & 0.59 (0.16, 2.10) \\
Kim 2012 & 2 7 & 56 17.0% & 1.47 (0.59, 3.65) \\
Lee 2012 & 2 7 & 30 8.9% & 0.38 (0.11, 1.33) \\
\hline
Total (95% CI) & 214 & 231 & 100.0% & 0.82 (0.57, 1.20) \\
\hline
Total events & 35 & 47 & & & \\
Heterogeneity: $T^2 = 0.00; C^2 = 3.27, df = 4 (P = 0.51); I^2 = 0%$ \\
Test for overall effect: $Z = 1.02 (P = 0.31)$ \\
\hline
\end{tabular}
\caption{Fig 5. Rotator cuff retear rates at minimum of 1 year of follow-up. No difference was observed between the EPM and immobilization groups. Meta-analysis results are shown for the 5 included studies. Data are reported as risk ratios between the EPM and immobilization groups with 95% CIs. A positive risk ratio indicates a higher retear rate in the EPM group. The size of each box is proportional to the study weight in the meta-analysis. The bars on either side of the boxes represent the 95% CI. (M-H, Mantel-Haenszel; Random, random-effects model.)}
\end{table}
studies produced the least conservative results. We chose to report the more conservative random-effects model data but did believe that the study by Lee et al. warranted inclusion. Although it allowed forward flexion to 90° with a continuous passive motion device in the "immobilization" group, the other programs also passively flexed to 90°. In addition, although the amount of supervised therapy was higher in the study by Lee et al., the patients in the other 3 studies participated in a home exercise program with similar amounts of total passive motion.

Limitations
With respect to internal validity, there are several limitations to this study. The principal concerns are the methodologic limitations and moderate risk of bias of 3 of the 5 randomized studies included in the meta-analysis. The standardized questions put forth by the Cochrane Collaboration were reviewed in duplicate for methodologic quality. A green plus sign indicates a low risk of bias. A red minus sign indicates a high risk of bias. If neither a plus or minus sign is present, insufficient data were available in the article to comment on the risk of bias.

NOTE. The meta-analysis conclusions are not significantly affected by the choice of a random- or fixed-effects model or by the inclusion or exclusion of the study by Lee et al., which had slightly more aggressive rehabilitation regimens than the other 3 studies.

Table 3. Results of Sensitivity Analysis

<table>
<thead>
<tr>
<th></th>
<th>Mean Difference (°)</th>
<th>Retear Rate (Risk Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FF at 3 mo</td>
<td>ER at 3 mo</td>
</tr>
<tr>
<td>Random-effects model</td>
<td>All studies</td>
<td>14.70; 95% CI, 5.52 to 23.87; P = .0002</td>
</tr>
<tr>
<td></td>
<td>Lee et al. (2012)</td>
<td>14.70; 95% CI, 1.87 to 27.53; P = .02</td>
</tr>
<tr>
<td>Fixed-effects model</td>
<td>All studies</td>
<td>12.84; 95% CI, 7.79 to 17.90; P &lt; .0001</td>
</tr>
<tr>
<td></td>
<td>Lee et al. (2012)</td>
<td>11.87; 95% CI, 6.07 to 17.67; P &lt; .0001</td>
</tr>
</tbody>
</table>

Fig 6. Risk of bias summary. The 5 studies included in the meta-analysis were reviewed in duplicate for methodologic quality using the standardized questions put forth by the Cochrane Collaboration. A green plus sign indicates a low risk of bias. A red minus sign indicates a high risk of bias. If neither a plus or minus sign is present, insufficient data were available in the article to comment on the risk of bias.

Allocation concealment (selection bias)
Blinding of participants and personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
meta-analysis. All 5 studies provide only Level II data because of either incomplete reporting or inaccurate procedures in their protocols or because of a small sample size. The most common flaw within these studies was that the treating surgeons, who were not blinded to the therapy protocol, were responsible for outcome assessments. Range-of-motion reporting can be particularly subjective, and detection bias could certainly explain the small differences seen between the EPM and immobilization groups. In addition, all of the studies suffered from performance bias because neither surgeons nor patients could be blinded to the treatment-group assignment. Analysis of functional outcomes in this study was not possible because of the small number of RCTs available in the literature and the heterogeneity among these studies.

With respect to external validity, there are several key points to remember in interpreting our results. The randomized studies included in the meta-analysis looked at primary arthroscopic rotator cuff repair in patients with small to medium tears (1 to 3 cm). All studies excluded patients with prior shoulder surgery, patients with massive rotator cuff tears, patients with Workers' Compensation insurance, and patients with preoperative shoulder stiffness. All but 1 of the studies excluded patients with simultaneous biceps tenotomy or tenodesis. The mean age across studies was 55 to 65 years. Fortunately, these exclusion criteria were homogeneous across studies, making meta-analysis of results possible. The most common procedures in their protocols or because of a small sample size. The clinical importance of these differences has yet to be determined. Retar at a minimum of 1 year of follow-up are not clearly affected by type of rehabilitation.

Conclusions

A small number of RCTs with low to moderate risks of bias are currently available. Meta-analysis suggests that after primary arthroscopic rotator cuff repair of small to medium tears, EPM results in 15° of improved forward flexion at 3 months and approximately 5° at 6 and 12 months. External rotation is improved by 10° with EPM at 3 months only. The clinical importance of these differences has yet to be determined. Retar at a minimum of 1 year of follow-up are not clearly affected by type of rehabilitation.

References


