The costs associated with the perioperative management and treatment of articular cartilage lesions of the knee

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Disclosures

• Jeffrey C. Wang, MD
  • Stock options from PearlDiver, Inc.
Introduction

- Articular cartilage lesions of the knee present a significant therapeutic challenge.
- These injuries are increasingly seen in young, athletic populations.
- 5.0% annual incidence growth in cartilage repair procedures over the last decade (McCormick et al. *Arthroscopy* 2014)
  - Microfracture
  - Osteochondral autografts (OATs)
  - Osteochondral allograft (OC allograft)
  - Autologous chondrocyte implantation (ACI)
Few studies have investigated the direct charges incurred during the preoperative, surgical, and postoperative management of articular cartilage lesions of the knee.

PURPOSE:
To examine the nationwide charges associated with the pre- and postoperative management of patients who have had cartilage repair or restoration surgery (i.e., microfracture, OATs, OC allograft, or ACI) as well as the direct charges associated with each surgical procedure.
Materials & Methods

- Retrospective review: PearlDiver database, 2008-2010
- Patients identified using CPT codes for microfracture, OATs, OC allograft, and ACI
- Perioperative management charges were recorded for the 1-year period before cartilage repair surgery and the 1-year period after
- Charges represented as per-patient average charges (PPACs)

\[
PPAC = \frac{\text{sum of relevant charges}}{\text{total number of patients receiving one type of cartilage surgery}}
\]
Materials & Methods

- Preoperative evaluation and management categories
  - Imaging (MRI, plain radiographs)
  - Outpatient visits (office, ED)
  - Joint injections
  - Rehabilitation

- Postoperative management categories
  - Rehabilitation
  - Secondary procedures
    - Manipulation under general anesthesia
    - Irrigation and debridement
    - Secondary arthroscopy
Results

- 41,191 patients underwent a cartilage repair surgery

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of Patients</th>
<th>% of Total Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microfracture</td>
<td>38,444</td>
<td>93.3%</td>
</tr>
<tr>
<td>OATs</td>
<td>1,130</td>
<td>2.7%</td>
</tr>
<tr>
<td>OC Allograft</td>
<td>1,071</td>
<td>2.6%</td>
</tr>
<tr>
<td>ACI</td>
<td>546</td>
<td>1.3%</td>
</tr>
</tbody>
</table>
Results

PPAC of cartilage repair or restoration procedures

- Microfracture: $3,990
- OATs: $6,110
- OC Allograft: $6,671
- ACI: $10,195
Results

Distribution of PPACs for preoperative management

- **Imaging**
- **Outpatient Visits**
- **Rehabilitation**
- **Joint Injections**

### Microfracture
- $72
- $299
- $425
- $1,102

### OATs
- $60
- $548
- $493
- $1,390

### OC Allograft
- $74
- $745
- $539
- $1,413

### ACI
- $102
- $721
- $422
- $1,043
Results

Distribution of PPACs for postoperative management

- Rehabilitation
- Secondary procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Rehabilitation</th>
<th>Secondary procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microfracture</td>
<td>$1,139</td>
<td>$261</td>
</tr>
<tr>
<td>OATs</td>
<td>$2,609</td>
<td>$464</td>
</tr>
<tr>
<td>OC Allograft</td>
<td>$2,960</td>
<td>$390</td>
</tr>
<tr>
<td>ACI</td>
<td>$2,804</td>
<td>$783</td>
</tr>
</tbody>
</table>
When PPACs for preoperative management, surgery, and postoperative management were consolidated:

<table>
<thead>
<tr>
<th>Type of Patient</th>
<th>Overall PPAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microfracture patient</td>
<td>$7,259</td>
</tr>
<tr>
<td>OATs patient</td>
<td>$11,512</td>
</tr>
<tr>
<td>OC Allograft patient</td>
<td>$12,707</td>
</tr>
<tr>
<td>ACI patient</td>
<td>$16,017</td>
</tr>
</tbody>
</table>
Results

Incidence and PPACs of secondary procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Incidence</th>
<th>PPAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary arthroscopy</td>
<td>9.3%</td>
<td>$349</td>
</tr>
<tr>
<td>- ACI</td>
<td>3.2%</td>
<td>$266</td>
</tr>
<tr>
<td>- OC Allograft</td>
<td>4.5%</td>
<td>$253</td>
</tr>
<tr>
<td>- OATs</td>
<td>4.7%</td>
<td>$231</td>
</tr>
<tr>
<td>Secondary procedures for infection</td>
<td>0.3%</td>
<td>$53</td>
</tr>
<tr>
<td>- ACI</td>
<td>*Less than 1%</td>
<td>$8</td>
</tr>
<tr>
<td>- OC Allograft</td>
<td>*Less than 1%</td>
<td>$28</td>
</tr>
<tr>
<td>- OATs</td>
<td>*Less than 1%</td>
<td>$11</td>
</tr>
<tr>
<td>Knee manipulation &amp; lysis of adhesions</td>
<td>4.2%</td>
<td>$381</td>
</tr>
<tr>
<td>- ACI</td>
<td>1.0%</td>
<td>$116</td>
</tr>
<tr>
<td>- OC Allograft</td>
<td>1.0%</td>
<td>$183</td>
</tr>
<tr>
<td>- OATs</td>
<td>0.6%</td>
<td>$20</td>
</tr>
</tbody>
</table>

*Less than 1% each for ACI, OC allograft, and OAT
Discussion

- To our knowledge, one of the first studies to investigate direct charges associated with cartilage repair or restoration procedures.

- Limitations:
  - PearlDiver database
    - Comprised of a single insurance payer
    - Study population may not be generalizable
  - Accuracy of physician coding
  - Charges vs. reimbursements
Conclusions

- Microfracture patients had the lowest PPAC while ACI had the highest.
  - Overall PPAC for ACI patients was **2.2 times** higher than that for microfracture patients.
  - Overall PPACs for OATs and OC allograft were **1.6** and **1.8 times** higher than that for microfracture, respectively.
- Overall charge for ACI likely higher due to the *in vitro* cell expansion procedure that this study did not assess.
- PPACs and incidences for secondary arthroscopy and joint manipulation/lysis of adhesions were notably higher for ACI patients.
  - Consistent with known literature: 30% of all ACI patients experience graft hypertrophy (Niemeyer et al. *Arch Orthop Trauma Surg* 2015)
Thank you for attending!