Analysis of Internet Information on Lateral Lumbar Interbody Fusion

REBEKAH BELAYNEH, BA; ADDISU MESFIN, MD

Lateral lumbar interbody fusion (LLIF) is a surgical technique that is being increasingly used. The authors’ objective was to examine information on the Internet pertaining to the LLIF technique. An analysis was conducted of publicly accessible websites pertaining to LLIF. The following search engines were used: Google (www.google.com), Bing (www.bing.com), and Yahoo (www.yahoo.com). DuckDuckGo (www.duckduckgo.com) was an additional search engine used due to its emphasis on generating accurate and consistent results while protecting searchers’ privacy and reducing advertisements. The top 35 websites providing information on LLIF from the 4 search engines were identified. A total of 140 websites were evaluated. Each website was categorized based on authorship (academic, private, medical industry, insurance company, other) and content of information. Using the search term lateral lumbar interbody fusion, 174,000 Google results, 112,000 Yahoo results, and 112,000 Bing results were obtained. DuckDuckGo does not display the number of results found for a search. From the top 140 websites collected from each website, 78 unique websites were identified. Websites were authored by a private medical group in 46.2% of the cases, an academic medical group in 26.9% of the cases, and the biomedical industry in 5.1% of the cases. Sixty-eight percent of websites reported indications, and 24.4% reported contraindications. Benefits of LLIF were reported by 69.2% of websites. Thirty-six percent of websites reported complications of LLIF. Overall, the quality of information regarding LLIF on the Internet is poor. Spine surgeons and spine societies can assist in improving the quality of the information on the Internet regarding LLIF. [Orthopedics. 2016; 39(4):e701-e707.]

Lumbar spinal fusion is a common procedure performed for the management of degenerative conditions presenting with instability or deformity.1 Traditionally, interbody fusions have been performed through open surgical approaches, in procedures such as anterior lumbar interbody fusion (ALIF), posterior lumbar interbody fusion (PLIF), and transforaminal lumbar interbody fusion (TLIF).2 However, developments in minimally invasive surgery have led to newer approaches with the thought of decreasing the morbidity of traditional open approaches.3-7 First presented in 2001, lateral lumbar interbody fusion (LLIF) is a minimally invasive alternative to ALIF and PLIF.8 This procedure is performed by accessing the disk space via a lateral, retroperitoneal, transpsoas approach. In addition, neuromonitoring with electromyography is used during the procedure to avoid injury to the lumbar plexus.8-10

The Internet, the most popular source of information today, continues to play a substantial role in providing medical and health information to patients outside the physician’s office.11-15 Of the 81% of Americans who use the Internet, 72%...
have sought health information online within the past year, and 43% have sought information about a particular medical treatment or procedure on the Internet. In addition, previous studies have demonstrated that patients self-educate using the Internet. The medical information that patients encounter on the Internet frequently informs their medical decisions and health care choices. According to the 2006 Pew Internet and American Life Project Report on Online Health Search, 58% of Internet users agreed that their last search affected a decision about how to treat a condition. However, studies have also shown the unreliability of Internet-based medical information used in patient self-education, particularly due to the Internet being a largely unregulated resource. As a result, patients could easily be misinformed or confused about the medical conditions and treatments they research on the Internet.

The current authors’ objective was to evaluate the content of information on the Internet about the LLIF procedure and to determine the overall quality of the information available to patients.

MATERIALS AND METHODS

Institutional review board approval was not obtained for this observational study because the author used publicly available data with no patient identifiers. Their Internet search methods were intended to mimic the patient experience of searching for medical information about LLIF. The current top 3 most-used search engines were used to search for information about LLIF: Google (www.google.com), Bing (www.bing.com), and Yahoo (www.yahoo.com). DuckDuckGo (www.duckduckgo.com) was an additional search engine used due to its emphasis on generating consistent results while protecting searchers’ privacy and reducing spam.

The Internet search was conducted from June 1, 2014, until June 30, 2014. The search term used in all 4 search engines was lateral lumbar interbody fusion. The top 35 sites were identified from each search engine, for a total of 140 websites to be investigated. The number of websites reviewed was determined by previously published reports. Duplicate websites within and between search engines were excluded, and 78 unique sites were identified and evaluated.

Each website was initially analyzed for authorship and categorized into 1 of 5 groups: private medical group, academic medical group, insurance company, biomedical industry, and other. Websites were then assessed for the following: descriptions of the LLIF procedure, diagrams of the LLIF procedure, inclusion and exclusion criteria for patients, description of surgical and nonsurgical alternatives, benefits, complications, and risks. Also evaluated was whether the websites contained industry-sponsored and peer-reviewed literature and direct means of contacting each website’s author(s).

Inclusion and exclusion criteria for LLIF included on the websites were individually analyzed for appropriateness based on published literature. The authors searched for 1 or more of the following patient inclusion criteria: degenerative disk disease, spinal stenosis, degenerative scoliosis, pseudoarthrosis, trauma, infection, and spondylolisthesis. The authors searched for the following exclusion criteria: severe spinal stenosis, vascular abnormalities, high-grade spondylolisthesis, previous retroperitoneal surgery, and severely collapsed disk spaces.

The following benefits of LLIF presented on the websites were also examined: avoidance of complications associated with anterior and posterior approaches, minimal invasive procedure, reduced anesthesia time, reduced blood loss, minimal scarring, reduced incision size, reduced postoperative pain, reduced hospital stay, and rapid recovery. Websites containing 1 or more of the following risks and complications associated with LLIF were recorded: postoperative pain, thrombosis, urinary tract infection, pneumonia, infection, pseudoarthrosis, stroke, nerve damage, and muscle weakness.

Each website was analyzed for the inclusion of 1 or more of the following surgical alternatives: ALIF, TLIF, PLIF, and posterolateral fusion (PLF). The authors evaluated whether each website included 1 or more of the following nonsurgical alternatives: diet, weight loss, exercise, rest or restricted activity, pain medications and management, physical therapy, chiropractic care, steroid injections, and acupuncture.

A binary system of analysis was used to indicate the provision or exclusion of each of the previously mentioned variables of analyzed websites. Each site was recorded as either providing the specific information or omitting it. The total number of websites was recorded, as well as the total number of sites within each category of authorship that provided sufficient information for each of the variables.

RESULTS

Search Results

Use of the search term lateral lumbar interbody fusion yielded 174,000 Google results, 112,000 Yahoo results, and 112,000 Bing results. DuckDuckGo does not display the number of results found for a search. From the top 140 websites collected from each search engine, 78 unique websites were found: 46% were authored by private medical groups, 27% by academic medical groups, 5% by the biomedical industry, 3% by insurance companies, and 19% by the “other” category, which included websites that did not meet the criteria of the other 4 (Table 1).

Inclusion Criteria

At least 1 suitable patient inclusion criterion was reported by 68% of all sites. In the academic medical groups, 81% of sites reported at least 1 indication for LLIF, whereas 47% of sites in the “other” category reported at least 1 appropriate indication. The top 3 inclusion criteria were...
degenerative disk disease (51%), scoliosis (44%), and spondylolisthesis (44%). Private medical group websites had an average 42% (range, 22%-61%) rate of reporting inclusion criteria, whereas the biomedical industry had an average of 17% (range, 0%-50%).

**Exclusion Criteria**

On average, 10.5% (range, 1%-21%) of websites reported exclusion criteria. Fifty percent of insurance company sites reported at least 1 contraindication, compared with only 7% of sites in the “other” category. Biomedical industry sites reported zero exclusion criteria.

**Benefits**

The minimally invasive nature of the LLIF procedure was reported by 53% of all websites. Thirty-six percent of websites reported that the LLIF procedure avoids the complications associated with ALIF and PLIF. The rapid recovery associated with LLIW was reported by 31% of all websites as a benefit, and 27% of all sites reported the reduction in blood loss associated with LLIF (Table 2).

**Complications**

At least 1 complication related to LLIF was reported by 36% of all websites. Nerve damage was the most common reported complication (28% of all sites) but was only reported by 19% of private medical group sites. For other commonly seen complications associated with the LLIF procedure, the reporting rates for all sites ranged from 9% to 28% (Table 3).

**Alternative Surgical and Nonsurgical Options**

Nonsurgical alternatives to the LLIF procedure were reported by 8% of the analyzed websites. Private medical groups were the only website authors to report nonsurgical alternatives, with a reporting rate of 17%. However, surgical treatment alternatives were reported by 50% of analyzed sites, with the highest rate (62%) reported by sites authored by academic medical groups. The reporting rates for surgical alternatives for all sites ranged from 24% to 46% (Table 4).

**Literature Cited**

Twenty-two percent of all websites used peer-reviewed citations: 6% of private medical groups, 33% of academic medical group sites, 25% of biomedical industry sites, 100% of insurance company sites, and 33% of websites in the “other” category. Industry-sponsored literature was present on 75% of biomedical industry websites, 31% of private medical group sites, 29% of academic medical group sites, and 0% of insurance company sites.

**Discussion**

This study was conducted to examine and analyze the information patients are accessing on the Internet regarding LLIF. According to the Pew Report on Health Online 2013, 77% of Internet users begin their Internet search for medical or health information on search engines such as Google, Bing, or Yahoo. Patients seek information that guides their decisions about the treatments and procedures health care providers offer.15,38 Later...
eral lumbar interbody fusion is a newer fusion approach, and clinical outcomes reported in the literature have been somewhat conflicting. Reported complication rates range from 1% to 60%. It is important for patients to have an accurate and appropriate understanding of the LLIF procedure. Because most patients rely on the Internet for medical information, the integrity of the information encountered on the Internet regarding the LLIF procedure needs to be critically analyzed.

Overall, this study’s results show that the information on LLIF available on the Internet is lacking. Only 68% of the websites reported at least 1 appropriate inclusion criterion, and 24% of websites reported at least 1 appropriate exclusion criterion. Eighty-one percent of websites authored by academic medical groups reported at least 1 proper indication. Websites authored by the “other” category had a reporting rate of 47% for at least 1 appropriate indication. Regarding exclusion criteria for LLIF, the biomedical industry had the least reporting of contraindications, with a rate of 0%. Benefits were reported by all websites at a rate of 69%, whereas only 36% of sites reported complications. Industry-sponsored literature

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Reported Benefits of Lateral Lumbar Interbody Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit</td>
<td>Private Medical Group</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Reduced anesthesia time</td>
<td>5 (14)</td>
</tr>
<tr>
<td>Reduced blood loss</td>
<td>12 (33)</td>
</tr>
<tr>
<td>Reduced postoperative pain</td>
<td>10 (28)</td>
</tr>
<tr>
<td>Reduced hospital stay</td>
<td>9 (25)</td>
</tr>
<tr>
<td>Reduced incision size</td>
<td>7 (19)</td>
</tr>
<tr>
<td>Rapid recovery</td>
<td>15 (42)</td>
</tr>
<tr>
<td>Minimally invasive</td>
<td>20 (56)</td>
</tr>
<tr>
<td>ADCR</td>
<td>16 (44)</td>
</tr>
<tr>
<td>Minimal scarring</td>
<td>9 (25)</td>
</tr>
<tr>
<td>Reduced surgical time</td>
<td>5 (14)</td>
</tr>
</tbody>
</table>

Abbreviation: ADCR, avoids damage, complications, or risks associated with other surgical options.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Reported Complications of Lateral Lumbar Interbody Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complication</td>
<td>Private Medical Group</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Postoperative pain</td>
<td>5 (14)</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>6 (17)</td>
</tr>
<tr>
<td>UTI</td>
<td>5 (14)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>5 (14)</td>
</tr>
<tr>
<td>Infection</td>
<td>7 (19)</td>
</tr>
<tr>
<td>Pseudoarthrosis</td>
<td>8 (22)</td>
</tr>
<tr>
<td>Stroke</td>
<td>4 (11)</td>
</tr>
<tr>
<td>Nerve damage</td>
<td>7 (19)</td>
</tr>
<tr>
<td>Muscle weakness</td>
<td>4 (11)</td>
</tr>
</tbody>
</table>

Abbreviation: UTI, urinary tract infection.
was reported by 32% of all websites; insurance companies reported no industry-sponsored literature. Twenty-two percent of all sites referenced peer-reviewed articles, with the lowest percentage of peer-reviewed articles reported by the private medical group (6%).

Also found was a deficiency in the presentation of nonsurgical treatment alternatives; physical therapy was the most commonly reported nonsurgical option (18%), and the average rate of reporting nonsurgical alternatives was 7.6%. Surgical alternatives to LLIF were reported by 28% of sites, and ALIF was the most commonly reported alternative (46%). The discrepancy between the reporting rates for nonsurgical and surgical alternatives shows not only the Internet’s inability to provide complete information; it also shows its capability of potentially establishing patient bias and guiding patients toward a particular treatment plan.

The Internet’s shortcomings as a patient education tool have been previously highlighted.\(^5\) Those seeking information about scoliosis on the Internet found a plethora of websites; however, the quality of information provided was poor.\(^5\) While examining Internet-based information on carpal tunnel syndrome, Beredjiklian et al\(^9\) reported that the quality of information available on the Internet was “questionable” and that 33% of websites examined had commercial interests. Krempec et al\(^4\) reported that patients primarily obtained information by using commercial search engines, which resulted in gaining access to incomplete and inaccurate information on the Internet. Labovitch et al\(^25\) reported that analyzed websites made claims about the advantages of minimally invasive total hip arthroplasty as it compared with the traditional approach. However, these purported benefits were unsubstantiated in the literature. Greene et al\(^28\) reviewed information about lumbar disk herniation on the Internet and reported that less than 10% of websites were considered “high quality” and 34% of the websites had an “element of commercial gain.”

The current study demonstrates that the Internet is not effective in providing comprehensive information about the LLIF procedure. The findings of this study are consistent with previously published reports assessing the quality and accuracy of Internet-based information. Mathur et al\(^25\) reported that academic-affiliated sites were the most accurate and had the highest quality content. Although academic-affiliated sites had the highest scores in quality and accuracy, the information on the sites was still deemed to be poor. This conclusion was reflected in the current study’s results; academic websites generally were the most comprehensive as compared with other authorship categories but were still lacking as a tool for patient education about the LLIF procedure. Labovitch et al\(^29\) reported that 91% of analyzed websites reported benefits of the minimally invasive total hip arthroplasty approach, whereas less than 18% of the websites made reference to its associated risks and complications. Garcia et al\(^13\) reported that 87% of sites featured the advantages of lumbar artificial disk replacement, whereas only 28% mentioned the possibility of complications. In a study evaluating Internet information on vertebroplasty, Sullivan et al\(^15\) reported that inclusions were referenced in 74% of sites, but only 45% of sites discussed exclusions. In the same study, benefits were reported by 100% of sites, but only 53% of sites outlined risks and 27% of sites contained peer-reviewed citations. The current study also reflected these trends. Inclusions and benefits were reported at higher rates than exclusions and complications, and few sites contained peer-reviewed citations.

A possible reason for the insufficiency of the Internet is that information on sites may not be intended by authors to educate patients but rather to promote authors’ practices or businesses. Garcia et al\(^13\) echoed this notion of the Internet being used as a marketing tool and medium between physicians and potential consumers seeking health care services. The results of the current study raise concerns that Internet-based information on LLIF acts as a patient recruitment tool more than a patient education tool. This is supported

<table>
<thead>
<tr>
<th>Surgical Alternative</th>
<th>Private Medical Group</th>
<th>Academic Medical Group</th>
<th>Biomedical Industry</th>
<th>Insurance Company</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALIF</td>
<td>18 (50)</td>
<td>12 (57)</td>
<td>1 (25)</td>
<td>0 (0)</td>
<td>5 (33)</td>
<td>36 (46)</td>
</tr>
<tr>
<td>PLIF</td>
<td>17 (47)</td>
<td>9 (43)</td>
<td>1 (25)</td>
<td>0 (0)</td>
<td>5 (33)</td>
<td>32 (41)</td>
</tr>
<tr>
<td>TLIF</td>
<td>8 (22)</td>
<td>8 (22)</td>
<td>1 (25)</td>
<td>0 (0)</td>
<td>2 (13)</td>
<td>19 (24)</td>
</tr>
<tr>
<td>PLF</td>
<td>1 (3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Abbreviations: ALIF, anterior lumbar interbody fusion; PLF, posterior lumbar fusion; PLIF, posterior lumbar interbody fusion; TLIF, transforaminal lumbar interbody fusion.
by the current study’s data on authorship because the data for each authorship category reflect the assumed personal interests of the authors. This seems to be particularly true for authorship categories most likely to benefit financially from patient recruitment, such as the biomedical industry. In this case, physicians and patients alike should be aware of the source of information. Physicians can promote education on the procedure by asking patients about the research they have performed on their condition and treatment options.

This study has several limitations. The authors limited the search query for LLIF to the first 35 websites per search engine. It is plausible that the findings may be different if more websites were evaluated. They also limited the search to 4 search engines, and other search engines may have led to different findings. The study focused on English-language websites; therefore, the results cannot be extrapolated to non–English-language websites. Although the authors speculated why certain websites may have exclusion/inclusion criteria or peer review literature whereas other websites do not, they did not contact each individual website or author for their rationale. It is possible an outside party may be designing the website with minimal content supervision by the physicians. Finally, there are no standardized guidelines for conducting an Internet search that mimics the patient experience, and this is an inherent limitation of this emerging research. However, with more interest and publications similar to the current study, the authors are optimistic that standards and guidelines will be developed.

**Conclusion**

Lateral lumbar interbody fusion is being increasingly used to manage routine and complex lumbar spine pathology. However, the quality of information on LLIF found on the Internet is poor. The Internet has become an important tool for the distribution of information to the masses. However, regarding patient education, it is a poor substitute for physician-patient consultations. When websites contain inaccurate or low-quality information, consultations with patients who have performed their own research online can be a challenge for physicians. The current study found that the majority (46.2%) of Internet information on LLIF is provided by private medical groups. Only 36% of websites reported the potential complications of LLIF, and most of the cited literature (32%) was from the biomedical industry. Spine surgeons and spine societies can assist in improving the quality of the information on the Internet regarding LLIF.

**REFERENCES**


