

**Internet Promotion of Direct Anterior Approach Total Hip Arthroplasty by Members of
the American Association of Hip and Knee Surgeons**

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7 **Association of Hip and Knee Surgeons**

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10 **Introduction:**

11 The Direct Anterior approach (DAA) in total hip arthroplasty (THA) is of significant interest to both
12 patients and surgeons, largely due to intense marketing. This study addressed the question, 'What is
13 the level of promotion of DAA THA on the internet by American Association of Hip and Knee Surgeons
14 (AAHKS) members?'

15
16 **Methods:**

17 An internet search was performed to identify surgeon-specific websites for each member of the AAHKS
18 using the members' full name and a previously published set of criteria. Each website was evaluated
19 utilizing a questionnaire to systematically identify claims made regarding proposed DAA specific risks,
20 benefits, as well as the presence/absence of supporting data.

21
22 **Results:**

23 We identified 1,855 qualified websites. The DAA was referenced on 22.8% (423/1,855) of these
24 websites. Claims regarding DAA specific benefits included; less invasive/muscle sparing (46.3%), quicker
25 recovery (45.2%), decreased pain (28.1%), decreased hospital stay (22.0%), and decreased dislocation
26 risk (16.3%). Potential DAA risks including lateral femoral cutaneous nerve injury, peri-
27 prosthetic/greater trochanteric fracture, and wound complication/hematoma were addressed on only
28 4.7%, 3.1%, and 1.7% of websites, respectively. Supporting peer-reviewed literature was identified on
29 only 3.6% of DAA websites.

30
31 **Conclusions:**

32 Over one fifth of AAHKS members promoted the DAA on the internet. Member websites claimed DAA
33 benefits such as faster recovery and decreased pain approximately nine times more frequently than any
34 potential risk of the procedure ($p < 0.001$). While AAHKS policy does not regulate member marketing, it
35 is the responsibility of all orthopaedic surgeons to disseminate accurate, validated information
36 concerning the procedures we perform.
37

38 Introduction

39 Total hip arthroplasty (THA) is one of the most successful surgical procedures in orthopaedics,
40 allowing patients with intractable pain and functional disability to return to higher levels of activity and
41 experience an improved quality of life^{1,2}. Numerous long-term follow up studies have identified
42 extremely high clinical success rates in terms of pain reduction, functional improvement, and
43 satisfaction utilizing traditional approaches to the surgery. In an era of decreasing reimbursement and
44 bundled payments, surgeons and hospital systems are increasingly motivated to search for techniques
45 to further reduce recovery time, post-operative pain, and hospital stay, while maintaining the excellent
46 outcomes and safety profile of traditional methods. The direct anterior approach (DAA) to THA has
47 garnered significant attention in part due to claims that the approach is associated with less muscle
48 damage and pain as well as accelerated recovery after hip arthroplasty³. Although there has been a
49 surge in popularity and widespread adoption and promotion of DAA THA by surgeons, hospitals, and
50 industry², there are few studies which establish long-term clinically significant benefits, safety, and
51 efficacy. Despite claims of superiority and significant marketing, several studies have been published
52 raising concerns regarding nerve damage⁴⁻⁶, muscle damage^{7,8}, blood loss⁹, wound problems¹⁰, femoral
53 failure¹¹, and a technical learning curve¹²⁻¹⁴.

54 The internet has become an important tool for patients to learn about their general medical
55 conditions and orthopaedic concerns. Moreover, public perception of the importance of the internet as
56 a source of health information has risen substantially¹⁵. Surgeon websites are an increasingly important
57 venue to market skills and attract new patients. There is little regulatory oversight regarding the validity
58 of claims made on these websites. As physicians, it is the responsibility of the each member of the
59 American Association of Hip and Knee Surgeons (AAHKS) to endorse and promote accurate, validated
60 information to our patients.

61 With this this in mind, our study had a 2-fold purpose: (1) to evaluate the level of promotion of
62 DAA THA available via internet sites associated with AAHKS members, and (2) analyze the extent of
63 specific claims made regarding DAA THA risks and benefits, and support from peer-reviewed literature.

64 **Materials and Methods**

65 In January 2016, 1,673 active fellow members of AAHKS were identified using the AAHKS
66 membership directory at <http://www.aahks.org>. We subsequently performed an internet search for
67 personalized websites associated with each AAHKS member. The search engine Google was used, with
68 the physician's name as the main keyword.

69 After the initial search, we examined potential websites for 7 criteria: physician picture,
70 biosketch, contact information, affiliations, specialty, certifications/education, and interests/research. If
71 at least 4 of the 7 criteria were found on the web site, it was included in the study. Utilizing a
72 modification of a previously published questionnaire (see appendix), each website was then evaluated
73 for claims made regarding the DAA THA specific benefits, risks, and supporting literature¹⁶⁻¹⁸. Study
74 websites were further classified based on the U.S. region in which AAHKS Fellows practiced using the
75 U.S. Census Bureau regions Midwest, Northeast, South, and West
76 (https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf). If a surgeon was
77 found to have three or more web sites which met inclusion criteria, the two web sites which met the
78 greatest number of the 7 criteria were included in the analysis.

79 DAA THA information was often found on institutional websites linked peripherally to a
80 physician's primary website. Therefore, we made an effort to distinguish between claims made by a
81 physician (direct claims) versus claims associated with the physician but endorsed by an institution
82 (indirect claims). Claims found on the primary physician website or within 2 clicks away from the
83 primary site are more likely to be interpreted by a patient as being endorsed by the surgeon and were
84 included in the analysis. Claims and information linked more peripherally to the surgeon website were

85 not included in this analysis. Previously published reports¹⁶⁻¹⁸ set the precedent for this distinction, and
86 it was used to minimize arbitrary evaluation of surgeon sites.

87 Results

88 Fifty (3.0%) of the 1,673 members of AAHKS in our review did not have an internet presence.
89 We identified 1,855 web sites associated with 1,623 AAHKS members for study inclusion. Study
90 websites were classified as private practice/clinic (n = 979; 52.8%), surgeon specific/personnel (n = 253;
91 13.6%), university system/hospital (n = 257; 13.9%), non-university hospital (n = 351; 18.9%), and other
92 (n = 15; 0.8%). Other websites consisted of organizational directory, foundation/institute, and industry
93 websites. Table 1 shows the breakdown of the 1,855 internet sites by U.S. region and territory. The
94 largest number of internet sites reviewed (616; 33.2%) were related to AAHKS Fellows from the
95 Southern U.S., followed by the Midwest (444; 23.9%), West (431; 23.2%) and Northeast (359; 19.4%)
96 U.S. Five additional sites (0.3%) were maintained by members in a U.S. territory.

97 Overall, the DAA was mentioned on 22.8% (n = 423) of the 1,855 internet sites in our review. By
98 comparison, the anterolateral (n = 43) and posterior (n = 87) approaches to THA were mentioned on
99 2.3% and 4.7% of sites, respectively ($\chi^2 = 520.5$, $p = 0.00001$). Figure 1 shows the proportion of internet
100 sites mentioning the DAA by region and territory. Excluding U.S. territories due to low cell counts, the
101 prevalence of internet mention of the DAA did not statistically differ by U.S. region ($\chi^2 = 2.200$, $p =$
102 0.532).

103 For internet sites on which the DAA was mentioned, Table 2 presents the proportion overall and
104 by U.S. region that explained the DAA to hip replacement. Explanation of the DAA ranged from a low of
105 34.7% in the South to a high of 47% in the Northeast but did not statistically differ based on region ($p =$
106 0.313). Table 2 also presents the proportion of internet sites by region that promoted various benefits
107 of the DAA. In general, few internet sites made a direct claim that the DAA approach was the best
108 approach to THA, but sites associated with Western Fellow Members of AAHKS were significantly more

109 likely to do so than sites in other regions of the country (Table 2, $p = 0.006$). Internet mention of 12
110 specific benefits associated with the DAA did not statistically differ by region (Table 2, $p \geq 0.174$); but
111 less tissue damage/minimally invasive/muscle sparing and faster recovery/earlier independence were
112 the most frequently mentioned benefits (45% or more of all sites). The least frequently mentioned
113 benefit was lower risk of revision (1 to 2% of sites).

114 Few internet sites referenced any DAA specific risks, and the proportion doing so did not vary by
115 region (Table 2, $p \geq 0.103$). Overall, 4.7% of sites mentioned the risk of lateral femoral cutaneous nerve
116 injury, 3.1% mentioned femoral or trochanter fracture, 1.7% mentioned hematoma and wound healing
117 problems, and 0.7% mentioned increased radiation exposure. Citation of peer-reviewed literature in
118 support of benefits and risks associated with the DAA was relatively rare, ranging from a low of 1.3% of
119 Southern U.S. internet sites to a high of 7.2% of Northeast U.S. internet sites ($p = 0.068$) (Table 2).

120 Internet mention of the DAA also was examined in relation to website classification. Of all DAA
121 mentions on the internet ($n = 423$), 53.7% were made on private practice/clinic websites, 21.0% were
122 made on surgeon specific/personnel websites, 15.1% were made on non-university hospital websites,
123 10.2% were made on university system/hospital websites, and none were made on websites classified
124 as other ($\chi^2 = 36.067$, $p < 0.001$).

125 **Discussion**

126 Under the auspices of improved patient care and enhanced outcomes, novel techniques and designs
127 are continuously being introduced in total joint arthroplasty, often with dubious levels of vetting and
128 variable amounts of success. In recent years, minimally invasive surgery¹⁹, computer assisted surgery²⁰,
129 robotic assisted surgery²¹, increased modularity²², alternative bearings²³⁻²⁵, alternative approaches²⁶,
130 and alternative fixation^{27, 28}, have been rapidly adopted into mainstream practice, some with excellent
131 results, and others with unexpected consequences.

132 The DAA to hip replacement has been widely marketed to patients with claims of improved stability,
133 less muscle damage, and greater overall superiority compared to other surgical approaches for THA². In
134 our study, over one fifth of AAHKS members promoted the DAA on the internet. Previous studies have
135 documented that marketing has biased claims of superiority without reference to peer-reviewed
136 literature². Personal computers provide open access to an abundant quantity of medical information via
137 the internet, but the quality of information is often uncertain. The promise of quicker recovery,
138 improved function, and less pain motivating many patients to seek out the DAA to THA may be tied to
139 marketing²⁹ which provides an incomplete picture of the risks and benefits associated.

140 Mohan et al² evaluated online information regarding the DAA in THA in 2015, and found that most
141 websites presented the DAA as “better” than other approaches, while only 35% described risks of the
142 approach, concluding that websites provide a limited perspective and may be focused on attracting
143 patients as opposed to accurate education. In our study, AAHKS member websites claimed DAA benefits
144 such as faster recovery and decreased pain approximately nine times more frequently than *any*
145 potential risk of the procedure ($p < 0.001$).

146 Recent studies evaluating the DAA have identified improved physical function for somewhere
147 between 6 days and 3 months³⁰⁻³³. In a randomized, prospective, controlled trial, Taunton et al³⁰ found
148 that patients receiving the DAA THA more rapidly discontinued the use of walking aids by 6 days, with
149 little additional benefit identified when compared to a posterior approach. Rodriguez et al³¹ observed
150 potential functional advantages early in recovery with a DAA cohort at 2 weeks, but cautioned that
151 these results may not be generalizable in a low-volume practice or during a surgeon’s learning curve. In
152 2016, Graves et al³⁴ found modestly improved physical function in a DAA cohort at 3 months, but later
153 concluded that greater blood loss and transfusion rate may obviate this transient benefit. Our study
154 found that over one fifth of AAHKS members promoted the DAA on the internet, with 45.2% of these
155 sites claiming faster recovery/earlier independence, often without addressing the modest and transient

156 nature of this benefit. We identified claims such as shorter hospital stay (22.0%), less pain (28.1%), and
157 less tissue damage/minimally invasive (46.3%), which are not well substantiated in the scientific
158 literature. Additionally, these outcomes are arguably as dependent on the hospital system, surgeon
159 skill, and pain protocols and not necessarily specific to surgical approach alone.

160 While modest, early functional benefit of the DAA THA may be real, this should be juxtaposed with
161 recent literature which suggests that the approach is associated with increased peri-prosthetic
162 fracture³⁵, femoral loosening¹¹, early revision rates³⁶, and incisional wound healing problems^{37,38}. Warth
163 et al¹⁶ evaluated internet promotion of minimally invasive TKA by AAHKS members in 2007, and found
164 that only 8.4% of surgeon websites referenced this technique. Importantly, 25% of sites identified by
165 the study addressed MIS-specific risks in TKA. While the increased internet presence of AAHKS
166 members observed in the current study (22.8% v. 8.4%) is not surprising, the rarity with which well-
167 documented DAA-specific risks were acknowledged demonstrates a lack of transparency on websites
168 presumably endorsed by AAHKS surgeons.

169 There are several limitations to the current study. The internet is a dynamic entity, and in
170 perusing thousands of websites over the course of just a few months, we provide a snapshot in time
171 which has the potential to change significantly. We would argue that such promotion will continue to
172 increase, and may be underreported by the current evaluation, as it does not incorporate promotion by
173 generalist or sports medicine physicians who may be utilizing and marketing the technique. Of note, it
174 is likely that a substantial number of surgeons are not intimately involved in the content or quality of
175 information which may be present on their website. In addition, it should be noted that surgeons are
176 more likely to specifically address DAA specific risks and benefits in the clinical setting when counselling
177 a patient pre-operatively.

178 The current study demonstrates that internet marketing of DAA THA preferentially highlights
179 several potential benefits of the approach, many of which are scientifically unproven, and often without

180 acknowledging well documented DAA specific risks. While the direct anterior approach is certainly a
181 viable option in THA, internet marketing paints an incomplete picture for public consumption which may
182 give potential patients a false perception of superiority of the DAA THA over traditional approaches.
183 While AAHKS policy does not regulate member marketing, it is the responsibility of all orthopaedic
184 surgeons to disseminate accurate, validated information concerning the procedures we perform.

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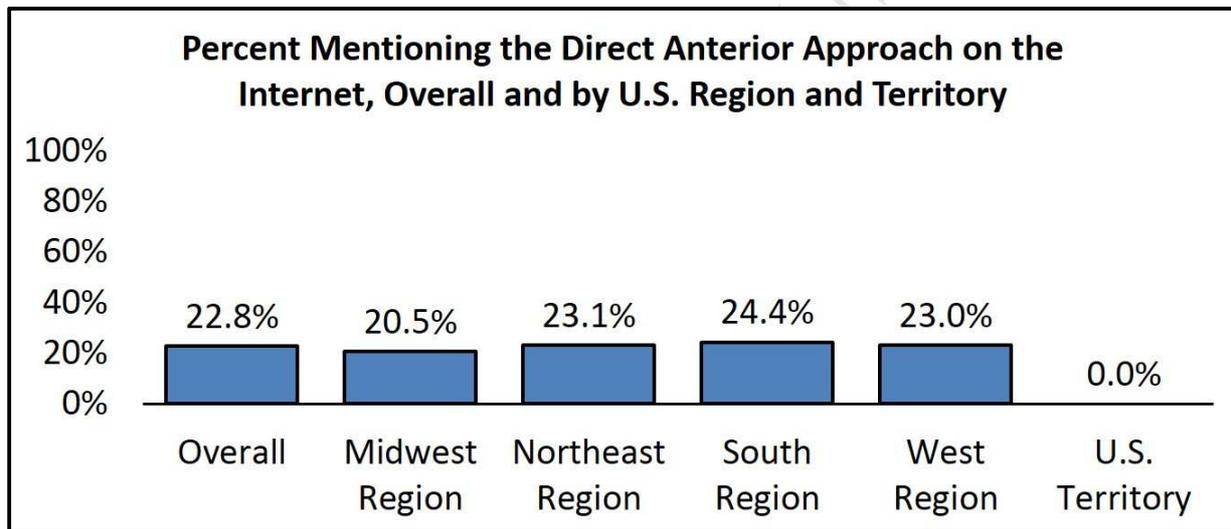
195

Table 1: Number of Fellow Members and Internet Sites, Overall and by U.S. Region/Territory

	No. of Fellow Members	No. of Websites
Overall	1625	1855
Midwest Region	381	444
Northeast Region	339	359
South Region	551	616
West Region	349	431
U.S. Territory	5	5

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199 **Figure 1**

Table 2: Benefits and Risks Provided on Internet Sites that Mentioned the Direct Anterior Approach, Overall and by U.S. Region

	Overall	Midwest Region	Northeast Region	South Region	West Region	χ^2	p
No. of sites that mentioned the DAA	423	91	83	150	99	2.200	0.532
DAA explained	38.3	37.4	47.0	34.7	37.4	3.559	0.313
Benefits Claimed							
Direct claim that DAA is best approach	1.9	0.0	1.2	0.7	6.1	12.452	0.006
Less tissue damage/minimally invasive/muscle sparing	46.3	46.2	42.2	48.7	46.5	0.909	0.823
Less blood loss	6.9	4.4	8.4	6.0	9.1	2.133	0.545
Less pain	28.1	30.8	26.5	26.7	29.3	0.647	0.886
Less medication	3.1	0.0	4.8	3.3	4.0	4.080	0.253
Faster recovery/Earlier independence	45.2	39.6	44.6	44.7	51.5	2.793	0.425
Better mobility/range of motion outcomes	12.1	15.4	14.5	7.3	14.1	4.964	0.174
Shorter surgery time	3.6	3.3	2.4	3.3	5.1	1.005	0.800
Shorter hospital stay	22.0	18.7	25.3	22.7	21.2	1.186	0.756
Safer/fewer complications	5.4	3.3	6.0	4.7	8.1	2.385	0.496
Lower dislocation risk	16.3	20.9	20.5	14.7	11.1	4.707	0.195
Lower revision risk	1.4	1.1	1.2	1.3	2.0	0.358	0.949
Less likely to have leg length discrepancy	7.8	6.6	7.2	10.7	5.1	2.976	0.395
Risks Mentioned							
Lateral femoral cutaneous nerve injury	4.7	2.2	7.2	4.0	6.1	3.013	0.390
Femoral or trochanter fracture	3.1	0.0	6.0	2.7	4.0	5.706	0.127
Hematoma	1.7	0.0	2.4	0.7	4.0	6.184	0.103
Wound healing problems	1.7	0.0	2.4	1.3	3.0	3.068	0.381
Increased radiation exposure	0.7	0.0	1.2	0.7	1.0	*	*
Peer review literature cited to support benefits/risks?	3.6	5.5	7.2	1.3	2.0	7.123	0.068
* χ^2 approximation invalid due to multiple cells with expected counts less than 5							

200 Appendix

201 Each study website was evaluated for information regarding the DAA to THA with the following
202 questionnaire

203

204 1. Was the DAA mentioned

205 2. If yes, was the DAA explained

206 3. Was a direct claim made that the DAA was the best approach for hip replacement

207 4. Were the following benefits associated with the DAA mentioned:

208 a. Less tissue damage/minimally invasive/muscle sparing

209 b. Less blood loss

210 c. Less pain

211 d. Less medication

212 e. Faster recovery/earlier independence

213 f. Better mobility/range of motion outcomes

214 g. Shorter surgery time

215 h. Shorter hospital stay

216 i. Safer/fewer complications

217 j. Lower dislocation risk

218 k. Lower revision risk

219 l. Less likely to have leg length discrepancy

220 5. Were the following risks associated with the DAA mentioned:

221 a. Lateral femoral cutaneous nerve injury

222 b. Femoral or trochanter fracture

223 c. Hematoma

224 d. Wound healing problems

225 e. Increased radiation exposure

226 6. Was peer-reviewed literature cited to support mentioned benefits and risks

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232 Bibliography

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- 234 1. Ethgen O, Bruyere O, Richy F, et al. Health-related quality of life in total hip and total knee
235 arthroplasty. A qualitative and systematic review of the literature. *The Journal of bone and joint surgery*
236 *American volume*. 2004;86-A(5):963-974.
- 237 2. Mohan R, Yi PH, Hansen EN. Evaluating online information regarding the direct anterior
238 approach for total hip arthroplasty. *The Journal of arthroplasty*. 2015;30(5):803-807.
- 239 3. Post ZD, Orozco F, Diaz-Ledezma C, et al. Direct anterior approach for total hip arthroplasty:
240 indications, technique, and results. *The Journal of the American Academy of Orthopaedic Surgeons*.
241 2014;22(9):595-603.
- 242 4. Bhargava T, Goytia RN, Jones LC, et al. Lateral femoral cutaneous nerve impairment after direct
243 anterior approach for total hip arthroplasty. *Orthopedics*. 2010;33(7):472.
- 244 5. Homma Y, Baba T, Sano K, et al. Lateral femoral cutaneous nerve injury with the direct anterior
245 approach for total hip arthroplasty. *International orthopaedics*. 2016;40(8):1587-1593.
- 246 6. Grob K, Monahan R, Gilbey H, et al. Distal extension of the direct anterior approach to the hip
247 poses risk to neurovascular structures: an anatomical study. *The Journal of bone and joint surgery*
248 *American volume*. 2015;97(2):126-132.
- 249 7. Mjaaland KE, Kivle K, Svenningsen S, et al. Comparison of markers for muscle damage,
250 inflammation, and pain using minimally invasive direct anterior versus direct lateral approach in total hip
251 arthroplasty: A prospective, randomized, controlled trial. *Journal of orthopaedic research : official*
252 *publication of the Orthopaedic Research Society*. 2015;33(9):1305-1310.
- 253 8. Bergin PF, Doppelt JD, Kephart CJ, et al. Comparison of minimally invasive direct anterior versus
254 posterior total hip arthroplasty based on inflammation and muscle damage markers. *The Journal of*
255 *bone and joint surgery American volume*. 2011;93(15):1392-1398.
- 256 9. Spaans AJ, van den Hout JA, Bolder SB. High complication rate in the early experience of
257 minimally invasive total hip arthroplasty by the direct anterior approach. *Acta orthopaedica*.
258 2012;83(4):342-346.
- 259 10. Christensen CP, Karthikeyan T, Jacobs CA. Greater prevalence of wound complications requiring
260 reoperation with direct anterior approach total hip arthroplasty. *The Journal of arthroplasty*.
261 2014;29(9):1839-1841.
- 262 11. Meneghini RM, Elston AS, Chen AF, et al. Direct Anterior Approach: Risk Factor for Early Femoral
263 Failure of Cementless Total Hip Arthroplasty: A Multicenter Study. *The Journal of bone and joint surgery*
264 *American volume*. 2017;99(2):99-105.
- 265 12. Woolson ST, Pouliot MA, Huddleston JI. Primary total hip arthroplasty using an anterior
266 approach and a fracture table: short-term results from a community hospital. *The Journal of*
267 *arthroplasty*. 2009;24(7):999-1005.
- 268 13. Masonis J, Thompson C, Odum S. Safe and accurate: learning the direct anterior total hip
269 arthroplasty. *Orthopedics*. 2008;31(12 Suppl 2).
- 270 14. Barton C, Kim PR. Complications of the direct anterior approach for total hip arthroplasty. *The*
271 *Orthopedic clinics of North America*. 2009;40(3):371-375.
- 272 15. Powell J, Inglis N, Ronnie J, et al. The Characteristics and Motivations of Online Health
273 Information Seekers: Cross-Sectional Survey and Qualitative Interview Study. *J Med Internet Res*.
274 2011;13(1).
- 275 16. Warth LC, Callaghan JJ, Liu SS, et al. Internet promotion of minimally invasive surgery and
276 computer-assisted orthopedic surgery in total knee arthroplasty by members of American Association Of
277 Hip And Knee Surgeons. *The Journal of arthroplasty*. 2007;22(6 Suppl 2):13-16.
- 278 17. Klein GR, Parvizi J, Sharkey PF, et al. Minimally invasive total hip arthroplasty: internet claims
279 made by members of the Hip Society. *Clinical orthopaedics and related research*. 2005;441:68-70.

- 280 18. Callaghan JJ, Warth LC, Liu SS, et al. Internet promotion of MIS and CAOS in TKA By Knee Society
281 members. *Clinical orthopaedics and related research*. 2006;452:97-101.
- 282 19. Mears DC, Mears SC, Chelly JE, et al. THA with a minimally invasive technique, multi-modal
283 anesthesia, and home rehabilitation: factors associated with early discharge? *Clinical orthopaedics and*
284 *related research*. 2009;467(6):1412-1417.
- 285 20. Parratte S, Ollivier M, Lunebourg A, et al. No Benefit After THA Performed With Computer-
286 assisted Cup Placement: 10-year Results of a Randomized Controlled Study. *Clinical orthopaedics and*
287 *related research*. 2016;474(10):2085-2093.
- 288 21. Domb BG, El Bitar YF, Sadik AY, et al. Comparison of robotic-assisted and conventional
289 acetabular cup placement in THA: a matched-pair controlled study. *Clinical orthopaedics and related*
290 *research*. 2014;472(1):329-336.
- 291 22. Cooper HJ. CORR Insights(R): Exchangeable Femoral Neck (Dual-Modular) THA Prostheses Have
292 Poorer Survivorship than Other Designs: A Nationwide Cohort of 324,108 Patients. *Clinical orthopaedics*
293 *and related research*. 2017.
- 294 23. Engh CA, Jr., Sritulanondha S, Korczak A, et al. No Difference in Reoperations at 2 Years Between
295 Ceramic-on-metal and Metal-on-metal THA: A Randomized Trial. *Clinical orthopaedics and related*
296 *research*. 2016;474(2):447-455.
- 297 24. Fehring TK, Odum S, Sproul R, et al. High frequency of adverse local tissue reactions in
298 asymptomatic patients with metal-on-metal THA. *Clinical orthopaedics and related research*.
299 2014;472(2):517-522.
- 300 25. Huang DC, Tatman P, Mehle S, et al. Cumulative revision rate is higher in metal-on-metal THA
301 than metal-on-polyethylene THA: analysis of survival in a community registry. *Clinical orthopaedics and*
302 *related research*. 2013;471(6):1920-1925.
- 303 26. Pagnano MW, Trousdale RT, Meneghini RM, et al. Patients preferred a mini-posterior THA to a
304 contralateral two-incision THA. *Clinical orthopaedics and related research*. 2006;453:156-159.
- 305 27. De Martino I, De Santis V, Sculco PK, et al. Long-Term Clinical and Radiographic Outcomes of
306 Porous Tantalum Monoblock Acetabular Component in Primary Hip Arthroplasty: A Minimum of 15-Year
307 Follow-Up. *The Journal of arthroplasty*. 2016;31(9 Suppl):110-114.
- 308 28. Vutescu ES, Hsiue P, Paprosky W, et al. Comparative survival analysis of porous tantalum and
309 porous titanium acetabular components in total hip arthroplasty. *Hip international : the journal of*
310 *clinical and experimental research on hip pathology and therapy*. 2017:0.
- 311 29. Trousdale WH, Taunton MJ, Mabry TM, et al. Patient Perceptions of the Direct Anterior Hip
312 Arthroplasty. *The Journal of arthroplasty*. 2016.
- 313 30. Taunton MJ, Mason JB, Odum SM, et al. Direct anterior total hip arthroplasty yields more rapid
314 voluntary cessation of all walking aids: a prospective, randomized clinical trial. *The Journal of*
315 *arthroplasty*. 2014;29(9 Suppl):169-172.
- 316 31. Rodriguez JA, Deshmukh AJ, Rathod PA, et al. Does the direct anterior approach in THA offer
317 faster rehabilitation and comparable safety to the posterior approach? *Clinical orthopaedics and related*
318 *research*. 2014;472(2):455-463.
- 319 32. Parvizi J, Restrepo C, Maltenfort MG. Total Hip Arthroplasty Performed Through Direct Anterior
320 Approach Provides Superior Early Outcome: Results of a Randomized, Prospective Study. *The*
321 *Orthopedic clinics of North America*. 2016;47(3):497-504.
- 322 33. Zawadsky MW, Paulus MC, Murray PJ, et al. Early outcome comparison between the direct
323 anterior approach and the mini-incision posterior approach for primary total hip arthroplasty: 150
324 consecutive cases. *The Journal of arthroplasty*. 2014;29(6):1256-1260.
- 325 34. Graves SC, Dropkin BM, Keeney BJ, et al. Does Surgical Approach Affect Patient-reported
326 Function After Primary THA? *Clinical orthopaedics and related research*. 2016;474(4):971-981.

- 327 35. De Geest T, Vansintjan P, De Loore G. Direct anterior total hip arthroplasty: complications and
328 early outcome in a series of 300 cases. *Acta orthopaedica Belgica*. 2013;79(2):166-173.
- 329 36. Eto S, Hwang K, Huddleston JI, et al. The Direct Anterior Approach is Associated With Early
330 Revision Total Hip Arthroplasty. *The Journal of arthroplasty*. 2017;32(3):1001-1005.
- 331 37. Watts CD, Houdek MT, Wagner ER, et al. High Risk of Wound Complications Following Direct
332 Anterior Total Hip Arthroplasty in Obese Patients. *The Journal of arthroplasty*. 2015;30(12):2296-2298.
- 333 38. Jahng KH, Bas MA, Rodriguez JA, et al. Risk Factors for Wound Complications After Direct
334 Anterior Approach Hip Arthroplasty. *The Journal of arthroplasty*. 2016;31(11):2583-2587.

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Figure 1 Legend:

Regional breakdown of percent of websites mentioning Direct Anterior Approach to THA on the internet.

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