



An assessment of the readability and quality of elective orthopaedic information on the internet

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This study assessed the readability and quality of websites related to ; total hip replacement, total knee replacement and anterior cruciate ligament reconstruction using validated instruments. 225 websites were analyzed from Google, Yahoo and Bing. Readability was assessed using the Flesch Reading Ease Score and Flesch-Kincaid grade level. Quality was assessed using the LIDA tool, HON-code status and an original assessment tool. Only 13.7% were set at or below the recommended 6th grade readability level. 27.35% were HON-code certified. There was a wide variation in quality scores between websites and the information relating to the three procedures was inconsistent and generally of poor quality. Given the deficit in information it is important Orthopaedic surgeons provide patients with high quality, readable information or direct them to an appropriate source.

INTRODUCTION

The Internet as a source of patient information has become increasingly popular, with 80% of online users looking for health related information on the Internet (3). Accessing health related information has now become the third most popular Internet activity, surpassed only by email and search engine use (3). This new development is borne out in the Orthopaedic clinic setting on a daily basis. Access to the internet is increasing with recent studies showing that up to 95% of patients attending Orthopaedic outpatient clinics have

access to the internet, with between 38-58% now researching their condition before attending (11,23).

The Internet as an information source is however unregulated and it has been extensively reported that the Orthopaedic information available is of variable reliability and overall poor quality (12,21). Importantly, this fact may not be apparent to the non-expert user. The American Academy of Orthopaedic Surgeons (AAOS) has proactively responded to the increasing use of the Internet by the establishment of a dedicated patient information website (7). It provides extensive high quality patient information on a broad range of Orthopaedic topics, which is evidence based and written by experts.

As well as ensuring patients have access to high quality, accurate information, this information must also be available at a level appropriate for the reader. The average American adult reads at an

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eight-grade level with 40 million reading below a fifth grade level (15,20). Several healthcare agencies have recommended that all patient information material should be written at or below a sixth grade level (5). Despite this, two separate studies concluded that only 2% of articles on the AAOS patient information website were written at the recommended readability level (10,26). This highlights the fact that even when accurate, high quality information is available, a significant proportion of the population may not be able to understand it.

The aim of this study was to assess the quality and readability of online patient information relating to three selected, commonly performed elective Orthopaedic procedures: total hip replacement; total knee replacement, and; anterior cruciate ligament reconstruction.

MATERIALS AND METHODS

Three common elective Orthopaedic procedures were chosen for analysis: total hip replacement, total knee replacement and anterior cruciate ligament (ACL) reconstruction. Total hip and knee arthroplasty were chosen given the current and projected high demand for these effective procedures (19). ACL reconstruction was chosen in an attempt to assess information that is aimed at a potentially younger cohort of patients.

The search terms "total hip replacement" or "hip replacement"; "total knee replacement" or "knee replacement" and "ACL reconstruction" or "ACL repair" were entered into the three most commonly used search engines in 2012: Google, Yahoo and Bing (1). Each search was performed using the advanced search feature under exact phrase and English only filters from a local IP address in December 2012.

Most internet users visit fewer than 25 websites from a search result (16), therefore for each procedure, the top 25 websites from each search engine result were initially analyzed, with a total of 75 websites for each procedure and 225 in total (Fig. 1). Websites were excluded from further analysis if duplicate findings were noted between search engines, if the site was inaccessible, if the site was solely for advertisement, non relevance and formats not aiming to provide information (e.g. videos, blogs, forums etc.).

Readability of written material can be defined as an objective measure of the reading skills an individual must possess to understand the material (9). The readabil-

ity of each website was assessed using two validated commonly used readability assessment tools – The Flesch Reading Ease Score (FRES) and the Flesch-Kincaid grade level (FKGL) (18,25). The FRES score is calculated based on the total words, syllables and sentences of a written passage using the following formula; $206.835 - 1.015 (\text{total words}/\text{total sentences}) - 84.6 (\text{total syllables}/\text{total words})$. The formula assigns a readability score 0-100, with higher scores indicating increasing ease of reading and lower scores indicating more difficult text. The FKGL is calculated using the formula; $0.39 (\text{total words}/\text{total sentences}) + 11.8 (\text{total syllables}/\text{total words}) - 15.59$. It corresponds to the US reading grade level and is inversely proportional to the FRES. For consistency the FRES and FKGL score for each website was assessed using an online readability calculator (8).

The online LIDA tool (Innervation Ltd, UK) is a 41-question online assessment algorithm that assesses the quality of health related websites on the Internet (4). It assesses the accessibility, reliability and usability of each website using a free online assessment tool. The LIDA assessment was performed on all included websites. Each website was assigned a score 0-100 for accessibility, reliability, usability and total. A score > 90 was suggested of a good result, while < 50 was considered poor as per the LIDA assessment protocol.

An original qualitative core information checklist was developed by the senior Orthopaedic author specific to each of the three procedures. The required core information was based on the standardized British Orthopaedic Association online consent forms for each procedure (6). Each website was assessed using the relevant original checklist and assigned a total qualitative score. Each checklist contained 16 items. 2 marks were awarded for adequate information, 1 mark for incomplete information and 0 marks for inadequate/incorrect information for each question. The maximum mark achievable was 32. The three original checklists and scoring system are presented in Fig. 2.

The Health on the net Foundation is a non-governmental organization, established to ensure the quality of health information on the Internet. They provide HON-code certification to websites which meet their standards and can be used as a measure of reliability (2). The HON-code status of each website was evaluated and recorded as being either present or absent.

Statistical Analysis

Statistical analysis was performed using STATA Version 12.1. All data was collated on a Microsoft

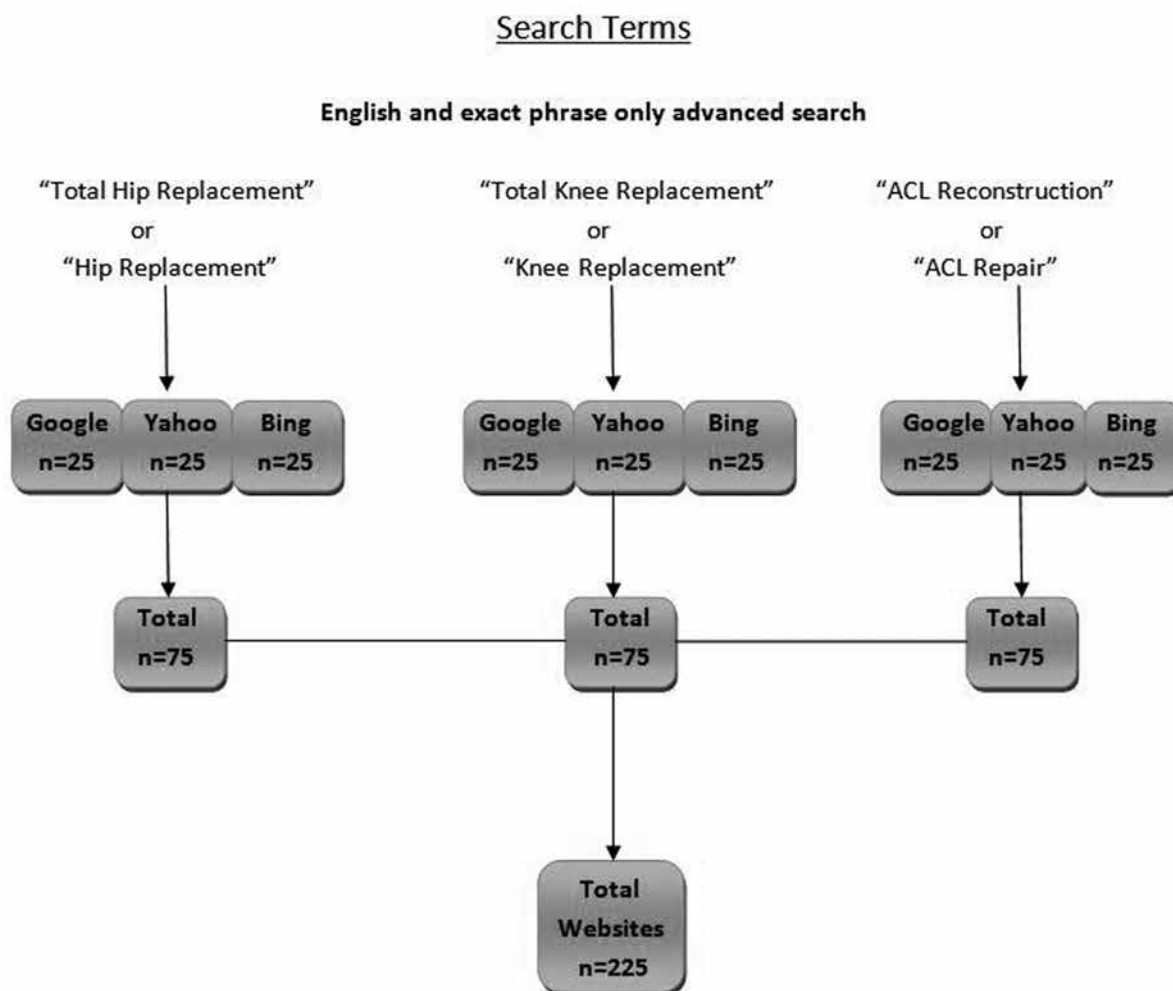


Fig. 1. — Flow diagram demonstrating creation of a list of 75 websites for each surgical procedure

Excel[®] (Microsoft Corporation, Seattle WA, USA) spreadsheet. Results were analyzed and are presented as mean, percentage and standard deviation as appropriate. Statistical significance was assessed using the student t test, with significance set at $P < 0.05$.

RESULTS

The three search terms returned a combined total of 43,571,000 results, highlighting the vast amount of information available on the Internet relating to these three procedures. Overall search results for each procedure and search engine are presented in Table I. Of the 225 websites initially analyzed, 109

were excluded from further analysis according to the set exclusion criteria as outlined above (Fig. 3).

Readability

The mean FRES score was 56.5 +/- 13.4 for THR, 54.5 +/- 11.3 for TKR, 52.3 +/- 12.4 for ACL and 54.6 +/- 12.5 overall. Similarly the mean FKGL was relatively high, 7.9 for THR, 8.3 for TKR and 8.4 for ACL. Only 13.7% (16/116) of the websites had a readability level at or below the recommended 6th grade level, as can be seen by the scatterplot analysis of the reading grade level for each website in Fig. 4.

Total Hip Replacement		Total Knee Replacement		ACL Reconstruction	
Basic Anatomy	Correct & appropriate	Basic Anatomy	Correct & appropriate	Basic Anatomy	Correct & appropriate
Indications	Osteoarthritis Alternatives: e.g exercise, weight loss, physiotherapy etc	Indications	Osteoarthritis Alternatives: e.g arthroscopy, exercise, weight loss, physiotherapy etc	Indications	Ruptured ACL Alternatives: e.g Avoiding strenuous activities, physiotherapy etc
Procedure	Anaesthetic Ball & Socket	Procedure	Anaesthetic Artificial knee joint	Procedure	Anaesthetic Tourniquet Arthroscopy Graft & fixation
Post-op	Anticoagulation Physiotherapy Mobilisation Rehabilitation	Post-op	Anticoagulation Physiotherapy Mobilisation Rehabilitation	Post-op	Physiotherapy Mobilisation Rehabilitation
Complications:	DVT Pain Leg length discrepancy Haemorrhage Infection Dislocation Revision	Complications:	DVT Pain Haemorrhage Knee Stiffness Wear of prosthesis Infection Revision	Complications:	Pain Swelling Instability Infection Stiffness Recurrence
Score Legend					
Adequate information = 2					
Inadequate information = 1					
Absent or incorrect information = 0					
Maximum Score = 32					

Fig. 2. — Original qualitative core information checklist for each of the procedures assessed ; THR, TKR and ACL Reconstruction

Table I. — total combined number of hits from each search engine for the three searches. Searches performed in December 2012

Search terms	Google	Yahoo	Bing	Total
THR	9,670,000	5,620,000	5,850,000	21,140,000
TKR	11,100,000	4,510,000	4,120,000	19,730,000
ACL	1,350,000	1,090,000	261,000	2,701,000
				43,571,000

Quality

LIDA assessment revealed overall poor reliability across all three procedures with mean reliability scores of 50.30 for THR, 61.44 for TKR and 50 for ACL, while the websites scored relatively well on accessibility. The complete LIDA scores are presented in Table II. There was a wide variation in the qualitative scores, with a considerable portion of websites not containing basic and often incorrect information relating to the procedure. The mean percentage qualitative score for THR sites was 74.8% TKR 73.7% and ACL reconstruction 60.3%, as presented in Table III. All websites received full

marks 2/2 in relation to the primary indication for the procedure. ACL Reconstruction related websites had a significantly lower overall mean score as compared to both THR (P = 0.0028) and TKR (P = 0.0131).

Only 27.6% (32/116) of the websites assessed in the study were HON-code certified. A significantly higher mean overall LIDA score was observed from HON-code certified websites compared to non HON-code certified websites 78.8 v 65.1 (P < 0.0001). There was no significant difference in readability 53.2 v 55.1 (P = 0.45) or qualitative scores 23.5 v 22 (P = 0.28) between the two groups.

DISCUSSION

While the readability of online arthroplasty-specific patient information has previously been shown to have been set at too high a level (24), we sought to establish simultaneously both the readability and quality of websites relating to THR, TKR and ACL reconstruction accessed through common search engines, the most popular starting point for a patient’s information search. To the best of our knowledge this is the first study to assess both the

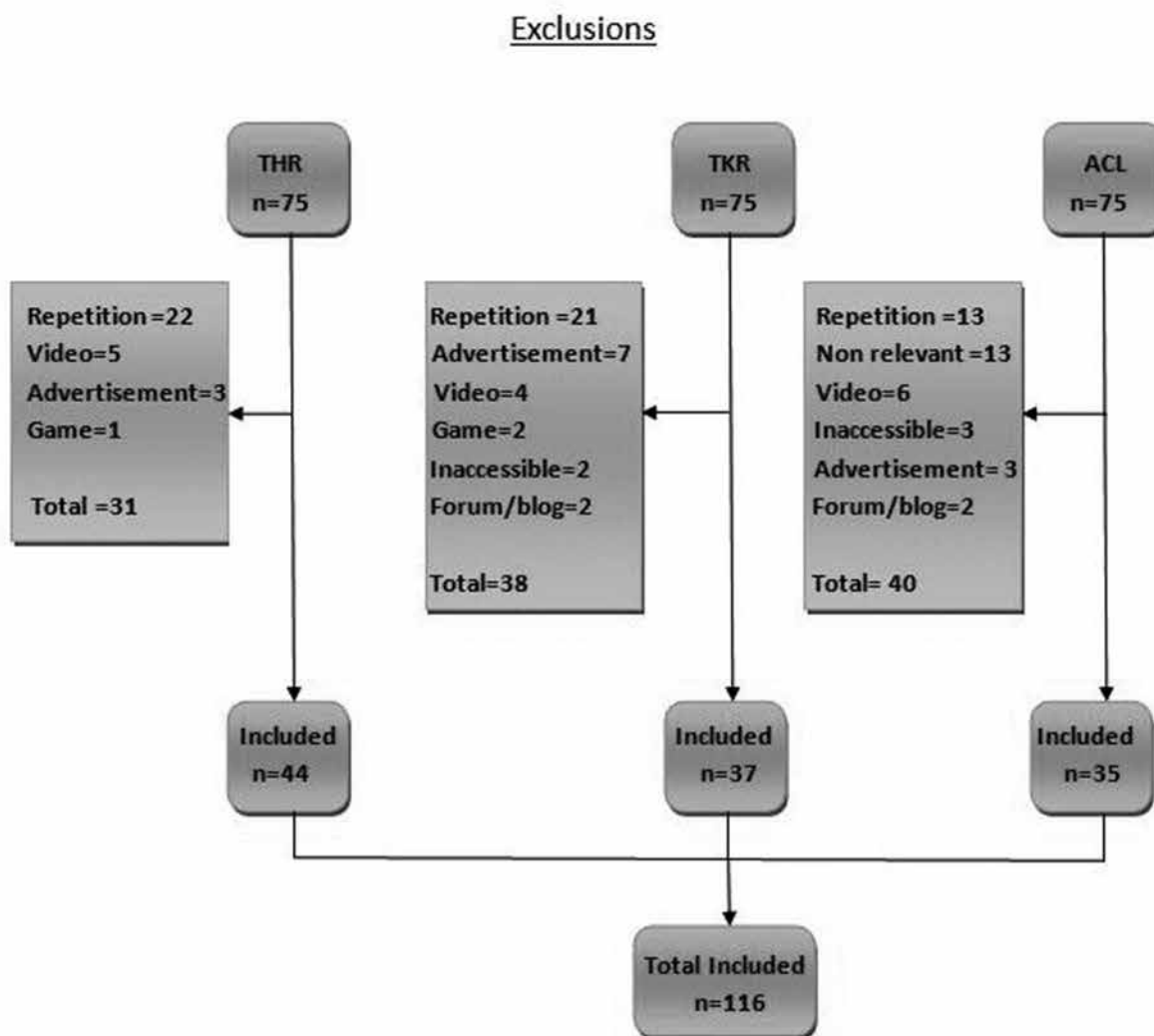


Fig. 3. — 116 sites were included in the analysis after exclusion criteria were applied

Table II. — quality assessment results according to the LIDA tool, Values presented are mean scores with (SD) in parentheses

LIDA scores	Accessibility	Usability	Reliability	Overall
THR	82.86 (10.11)	64.05 (15.34)	45.09 (19.97)	68.68 (11.12)
TKR	83.11 (12.05)	66.73 (19.38)	52.16 (22.33)	71.49 (12.64)
ACL	81.09 (11.72)	54.06 (20.49)	44.6 (20.34)	66.31 (10.3)
Total	82.41 (11.18)	61.89 (18.91)	47.2 (20.96)	68.86 (11.48)

Table III. — quality assessment results according to the original qualitative core information checklist. Values presented are mean scores with (SD) in parentheses and total mean percentage scores

Qualitative scores	Mean	% Score (Maximum 32)
THR	23.93 (5.41)	74.78% (23.93/32)
TKR	23.59 (6.4)	73.72% (23.59/32)
ACL	19.31 (7.84)	60.34% (19.31/32)
Total	22.43 (6.79)	70.1% (22.43/32)

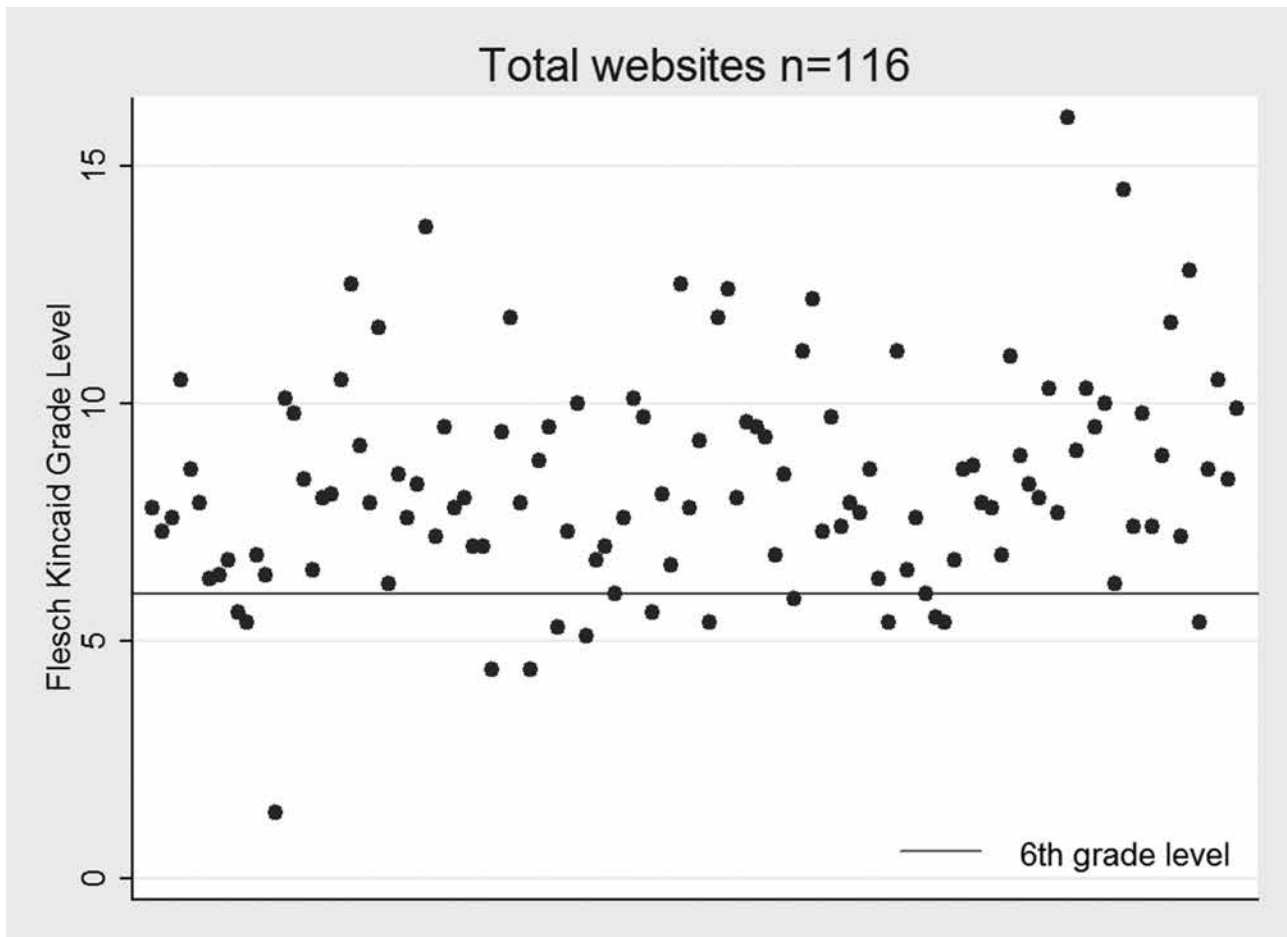


Fig. 4. — Scatterplot of the FKGL scores showing a vast minority of scores at or below the recommended 6th grade reading level

readability and quality of Internet information relating to these three procedures simultaneously. The results show that an alarmingly small proportion of websites (13%) relating to these common procedures were set at, or below, the recommended readability level. This suggests that a considerable proportion of the adult population may not be in a position to understand these websites irrespective of the quality of the information they contain.

These results further show that in general the accessibility of websites is good with an overall mean LIDA accessibility score of 82.41. While this is encouraging, accessibility in isolation is of little value unless the information is reliable. The overall mean reliability scores were poor (47.19). The finding of good accessibility with unreliable data is in keeping with previous studies which applied the

LIDA tool to health-care related websites in other surgical disciplines (17). The results from the originally designed qualitative checklist were variable with web sites scoring well in some areas and poor in others. Bruce Brand *et al* (14), recently developed their own original ACL-specific content score. They also reported variability in content scores between websites assessed, with an overall mean content score of 49.2%.

The results of this study revealed significantly higher overall LIDA scores in HON-code certified websites. This is in keeping with other similar studies by Nason *et al* and Bruce-Brand *et al* that showed that HON-code certified websites tended to obtain higher scores using other Internet quality assessment tools (14,22). However, there was no significant difference in the readability between

HON-code certified and non HON-code certified websites. While HON-code status may be useful as a marker of website content quality, the study did not reveal any discriminatory value of HON-code certification in assessment of the readability of a website.

The information a patient receives is of the utmost importance in relation to elective Orthopaedic procedures and is an essential component of informed consent (13). While the ultimate responsibility regarding information provision relating to the procedure may reside with the operating surgeon, the patient's own information sources need to be acknowledged. As has been shown in relation to THR, TKR and ACL reconstruction in this study, along with several previous studies relating to other health related information, a large proportion of the information available on the internet is unreliable (12,21,27) and a patient obtaining information independently may therefore have accrued inaccurate information relating to their potential procedure. This may lead to an incomplete or inaccurate knowledge of the established risks relating to their procedure. Similarly they may have unrealistic expectations relating to their procedure. Importantly the deficiency in the quality of this information may not be apparent to the non-expert user. Given this deficit, it may be necessary for all surgeons to provide their own readable, reliable information to their patients in verbal, written or electronic formats or else direct them to an appropriate source prior to attendance at the outpatient clinic. This may serve to reduce time clarifying incorrect preconceived patient beliefs in a busy outpatient clinic and perhaps more importantly, ensure that the patient is fully informed about their future potential procedure, allowing an informed discussion to take place.

The authors acknowledge a number of limitations to our study. A patient's understanding of a given text is based on a number of factors in addition to readability, such as associated illustrations or videos, which were not assessed using the readability formulae. This has been an acknowledged limitation of previous studies, which used similar methods (26). While every effort was made to include relevant information in the self designed qualitative

assessment tool, it is acknowledged that the information is not an exhaustive list in relation to each of the three procedures. This study attempted to include the most pertinent information as they related to the patient, which were based on the British Orthopaedic Association Consent guideline content (6). As with previous studies that have used health care evaluation tools, they are by their design subjective in nature. The LIDA tool aims to assess the accessibility, reliability and usability of websites. The accessibility is calculated using an automated formula, however the reliability and usability calculation is based on the subjective input of an assessor's evaluation of each website and this may be subject to bias.

As expected, given that all three search terms are commonly performed Orthopaedic procedures, there is a vast amount of Internet information available from a variety of sources. However, this study has found the usefulness and suitability of this information to be questionable. Despite this, there remains a huge potential for the internet to be harnessed as a patient information source in the future, with the development of reliable, readable material by health care professionals and the use of tools such as HON-code certification that allow users themselves discriminate amongst the vast volumes of information available.

In Conclusion the information relating to THR, TKR and ACL reconstruction on the Internet is inconsistent and often unreliable and is generally not suitable as a reliable patient information source at present. Even where high quality information is available it is often set at too high a level to be understood. Within this context it is important that Orthopaedic surgeons provide leadership and guidance and either provide their patients with their own high quality, readable information or direct them to an appropriate source, as the deficit in online information may not be apparent to the non-expert user.

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