Journal of Orthopaedic Experience & Innovation
Clinical, Economic, and Innovative Orthopaedic Experience

Mohamed, Ali A., Jared Kushner, Garrett R. Jackson, Aghdas Movassaghi, Howard Routman, and Vani Sabesan. 2025. "Does Sleep Comfort Predict Recovery After Primary and Revision Reverse Shoulder Arthroplasty?" *Journal of Orthopaedic Experience & Innovation*, July. https://doi.org/10.60118/001c.132263.

Research Article

Does Sleep Comfort Predict Recovery After Primary and Revision Reverse Shoulder Arthroplasty?

Ali A. Mohamed, BS, MS[1a], Jared Kushner, BS[1b], Garrett R. Jackson, MD[2c], Aghdas Movassaghi, BS[3d], Howard Routman, DO[4,5e], Vani Sabesan, MD[6f]

---

a Ali A. Mohamed, MS.DSA, MS.E is a third year medical student at Florida Atlantic University Charles E. Schmidt College of Medicine. He received his Bachelor of Science in Biology and his Bachelor of Science in Applied Physiology & Kinesiology from the University of Florida in 2020 with a distinction in honors. He then completed his Master of Science in Entrepreneurship at the the University of Florida Warrington College of Business in 2021, where he was recognized as a Social Impact and Sustainability Scholar for his leadership qualities and role as a changemaker in business. As a component of this distinction, he was awarded the Assembly for Action Grant for the development of a sustainable vaccine infrastructure for underprivileged members of the Gainesville community in collaboration with the Equal Access Clinic Network. Following his first masters, Ali began medical school and served as the Chief Strategy Officer for a software development firm and later, the founder and Chief Executive Officer of a Registered Investment Advisory. He then completed his Master of Science in Data Science and Analytics at the College of Engineering and Computer Science at Florida Atlantic University in 2024 as a component of his traineeship in Data Science and Technologies with the National Science Foundation. Additionally, he was awarded a graduate certificate in Artificial Intelligence and recognized as a National Research Trainee.
Currently, he serves on the CNS Medical Student Committee and is the AANS Chapter President at Florida Atlantic University. Ali also serves on the CSNS AI Ad Hoc Committee, tasked with the development of an Artificial Intelligence Use Policy in neurosurgery. Ali's unique research interests are multidisciplinary, converging the disciplines of medicine, computer science, and engineering. Following the completion of his masters in Data Science and Analytics and his formal training in artificial intelligence by the National Science Foundation, Ali has also accepted invitations to serve as a peer reviewer for artificial intelligence based medical submissions made to a number of journals including Journal of Neurological Surgery and others.

Visit Ali A. Mohamed

Connect with Ali A. Mohamed on LinkedIn

Conflicts of Interest Statement for Ali A. Mohamed

b Jared Kushner is a 4th-year medical student at the Schmidt College of Medicine at Florida Atlantic University. He is passionate about pursuing a career in orthopedic surgery.

Conflicts of Interest Statement for Jared Kushner

c Connect with Dr. Garrett R. Jackson on LinkedIn

Conflicts of Interest Statement for Dr. Garrett R. Jackson

d Aghdas Movassaghi is a medical student at Michigan State University College of Human Medicine, pursuing a career in orthopaedic surgery. She is currently completing a research intern year under Dr. Sabesan, with a focus on improving gender diversity and inclusion in orthopaedics, as well as investigating clinical outcomes in shoulder arthroplasty. Her research interests include examining the impact of bias in surgical literature and optimizing patient outcomes in orthopaedic procedures.

Conflicts of Interest Statement for Aghdas Movassaghi

e Dr.Howard Routman is a board certified orthopedic surgeon in private practice in palm beach county, Florida. As the Director of the Palm Beach Shoulder Service, his clinical and research focus is shoulder reconstruction. He is also the program director of the HCA Jfk / University of Miami Consortium orthopedic residency program and Associate Professor of Orthopedic Surgery at Nova-Southeastern University College of Medicine.

Visit Dr. Howard Routman

Connect with Dr. Howard Routman on LinkedIn

Conflicts of Interest Statement for Dr. Howard Routman

Visit the Open Payments Data Page for Dr. Howard Routman

f Dr.Sabesan is a board certified Orthopaedic Surgeon and Shoulder and Elbow specialist in Palm Beach, FL. She served as Chief of Quality and held the Lang Family Endowed Chair in Orthopaedic Research at Cleveland Clinic Florida. Before that she served as program Director of the Orthopaedic Residency Training Program at HCA Florida JFK/ University of MIAMI. Dr. Sabesan is passionate about research and leadership in her Orthopedic community. She has published over 105 articles in the peer reviewed literature and has served on a number of regional, national, and international committees and boards, including the Florida Orthopaedic Society Board and program chair, American Shoulder and Elbow Society Research and Advocacy committees, AAOS Shoulder and Elbow Committee, International Society for Technology in Arthroplasty Board, Michigan Orthopedic Society Board, Mid America Orthopaedic Society, and American Orthopedic Association (AOA) Emerging Leaders program. Dr. Sabesan's commitment to service extends beyond her role as female faculty member through her national work with Women's Leadership programs, RJOS, and medical mission work. Dr. Sabesan's contributions to the peer reviewed literature with over 105 publications demonstrates her continued commitment to excellence in clinical and biomechanical research. She lectures both nationally and internationally in her area of expertise. Dr. Sabesan has received numerous honors including the Lang Family Chair in Orthopaedic Research, Young Investigator Grant recipient, Scholar of the year at CCF Florida, RJOS traveling fellowship, MidAmerica Orthopaedic Association traveling fellowship, OREF Clinician Scientist.

[1] Charles E. Schmidt College of Medicine, Florida Atlantic University, [2] Department of Orthopaedic Surgery, University of Missouri, [3] College of Human Medicine, Michigan State University, [4] Palm Beach Shoulder Service, Atlantis Orthopaedics , [5] Department of Orthopedics, HCA JFK/University of Miami , [6] Orthopaedic Center of Palm Beach County

Keywords: Sleep Comfort, Reverse Shoulder Arthroplasty, Recovery, Patient Outcomes, Revision Surgery

https://doi.org/10.60118/001c.132263

Journal of Orthopaedic Experience & Innovation

Background

Sleep disturbances are common among patients with shoulder pathology and are often associated with poor postoperative outcomes, diminished quality of life, and increased healthcare use. Shoulder arthroplasty (SA) is a well-established treatment for functional limitations and pain due to glenohumeral osteoarthritis, with relief from nighttime pain and improved sleep quality frequently influencing patients' decisions to undergo surgery. While prior studies have documented the link between sleep disturbances and functional outcomes in shoulder surgery, the role of sleep in overall recovery remains unclear. This study evaluates the relationship between sleep comfort and recovery in patients undergoing primary and revision reverse shoulder arthroplasty (RSA).

Methods

A retrospective review of patients who underwent RSA by a single fellowship-trained orthopaedic surgeon from 2015-2020 was conducted. Patients were separated into two groups: 1) pRSA and 2) rRSA. Demographic variables, composite ASES scores, and individual responses to the sleep component of the ASES score were collected at 3, 6, 12, and 24 months postoperatively. Patients rated their ability to comfortably sleep on a 0-3 scale (0="unable", 1="very difficult", 2="slightly difficult", 3="normal"). If a score of 0-2 was obtained, patients were considered to have "difficulty" sleeping. Utilizing the ASES score, patients were deemed "recovered" if they obtained a postoperative score of 70 or greater based on previously defined methods.22,23 Patients were further grouped into "not recovered" and "recovered" groups and statistically compared to their sleep scores using a chi-square analysis.

Results

A total of 476 RSA patients (pRSA=386, rRSA=90) were included in the final analysis. Patients who underwent pRSA had a mean age of 73 years, BMI of 29.2 kg/m² and consisted of 37% males. Patients who underwent rRSA had a mean age of 68 years, BMI of 29.7 kg/m² and consisted of 51.7% males. Most patients that recovered indicated "no difficulty" sleeping by 3 months (pRSA group = 61.1%, rRSA group = 63.6%) and this incrementally improved up to one year for both pRSA and rRSA patients (6 months (RSA group = 69.1%, rRSA group = 73.3%), 12 months (RSA group = 69.4%, rRSA group = 75%). The recovered patients demonstrated significantly higher rates of "no difficulty" sleeping when compared to their respective "not recovered" patients at each time point ($p < 0.001$).

Conclusion

This study demonstrates a significant association between normal sleep restoration and recovery after RSA, with most patients achieving improved sleep by 3 months postoperatively. Sleep quality continued to improve through 12 months but plateaued thereafter, indicating a stabilization of recovery. These findings highlight the importance of sleep as a key indicator of recovery and suggest that surgeons can use sleep quality as a simple metric for assessing patient progress.

Visit Dr. Vani Sabesan

Connect with Dr. Vani Sabesan on LinkedIn

Conflicts of Interest Statement for Dr. Vani Sabesan

Visit the Open Payments Data Page for Dr. Vani Sabesan

INTRODUCTION

Over sixty percent of U.S. adults use the Internet to search for health or medical information (Cohen and Adams 2011), with over 93% of U.S. adults having Internet access (Wang and Cohen 2023). Many individuals utilizing online resources for health-related information are either patients or caregivers (Finney Rutten et al. 2019). The ability for both of these groups to easily access this information plays a large role in the management of health and disease currently (Finney Rutten et al. 2019). The Internet is used not only for answers to frequently asked medical questions, it is used for scheduling doctor's appointments, emailing healthcare providers, refilling prescriptions, and much more (Cohen and Adams 2011), making it an essential part of our healthcare system. Additionally, almost half of all U.S. adults have accessed websites that provide details on a specific medical ailment (Cohen and Adams 2011). However, recent studies have shown the vast majority of online health information is written at a readability level that is unsuitable for the average U.S. adult (Rooney, Santiago, Perni, et al. 2021; Daraz, Morrow, Ponce, et al. 2018). Both the American Medical Association (AMA) and the National Institutes of Health (NIH) recommend all materials directed to the general public should not exceed a sixth grade reading level (Weiss 2007).

Poor readability of online patient educational materials has many implications. Patients who are provided educational materials that are written at an appropriate grade level and displayed in an easy-to-understand format may have better adherence to medications and treatment plans (Hirsch et al. 2017; Daraz et al. 2009). Additionally, readable educational materials may decrease costs associated with health care and improve a patient's quality of life (Weiss 2007; Hirsch et al. 2017; Daraz et al. 2009).

Over 7.2 million individuals sustained an orthopaedic injury in 2014, with over 1.1 million of those individuals requiring emergency surgery due to the severity of their condition (Jarman et al. 2020). With an ever-growing population, it would be a safe assumption that the incidence of patients sustaining any type of orthopaedic trauma rises annually. It is estimated that over half of orthopaedic trauma patients use the Internet to look up information regarding their treatment or injury (Hautala, Comadoll, Raffetto, et al. 2021), although there are no comprehensive studies evaluating the readability of educational materials about the most common orthopaedic trauma conditions. The Orthopaedic Trauma Association (OTA) is an international organization dedicated to the care and treatment of patients with musculoskeletal injuries, with a member base comprised of both surgeons and other medical professionals. While the OTA participates in many research endeavors, it is also known for its educational resources due to one of its goals of improving and advancing the knowledge base of everything pertaining to orthopaedic trauma. The OTA website includes a section for patient education entitled "Learn about Your Injury", where patients and caregivers can select an area of the body and learn more about the most common orthopedic trauma conditions sustained within that area. Each of the conditions listed on the OTA website was evaluated in this study.

The aim of this study is to review online patient educational resources for the most common orthopaedic trauma procedures and assess their understandability, actionability, and readability. This will provide insight on whether the average patient is able to understand the content within these websites. Additionally, this study will supply orthopaedic surgeons with the tools necessary to recommend appropriate online educational materials to their patients by providing awareness on what information their patients are viewing online both before they receive treatment and during their recovery.

MATERIALS AND METHODS

WEBSITE / CONTENT SELECTION

Institutional, organizational, and academic websites were included in this study. Private surgeon websites and journal articles requiring access fees, payment, or a subscription to view content were not analyzed in this study. All orthopaedic trauma conditions listed on the OTA website under the "Learn about Your Injury" section within the "For Patients" tab were entered into the search engine, Google, utilizing an incognito search with all cookies, location, and user account information disabled. All content included in this study was accessed by a single investigator on June 15, 2024.

The conditions searched include the following: (1) Scapula Fracture; (2) Shoulder Dislocation with Fracture; (3) Proximal Humerus Fracture; (4) Humeral Shaft Fracture; (5) Clavicle Fracture; (6) Distal Humerus Fracture; (7) Olecranon Fracture; (8) Radial Head Fracture; (9) Elbow Dislocation; (10) Broken and Dislocated Elbow; (11) Forearm Fracture; (12) Distal Radius Fracture; (13) Posterior Wall Acetabular Fracture; (14) Young Patients with Femoral Neck Fracture; (14) Periprosthetic Hip Fracture; (15) Pelvis Fracture; (16) Femoral Head Fracture; (17) Acetabular Fracture; (18) Intertrochanteric Fracture; (19) Geriatric Femoral Neck Fractures; (20) Periprosthetic Distal Femur Fracture; (21) Femoral Shaft Fracture; (22) Distal Femur Fracture; (23) Patella Fracture; (24) Knee Dislocation; (25) Tibial Plateau Fracture; (26) Pilon Fracture; (27) Ankle Fracture; (28) Tibial Shaft Fracture; (29) Talus Fracture; (30) Calcaneus Fracture; (31) Metatarsal Fracture; and (32) Lisfranc Injury.

While searching each condition online, the five most visited websites for each condition were collected. In total, there were 160 patient education entries. Each entry was analyzed using Flesh-Kincaid (FK) scoring for Reading Ease and Grade Level, as well as the Patient Education Materials Assessment Tool (PEMAT) Understandability and Actionability metrics.

READABILITY ANALYSIS

The FK analysis is subdivided into two parts: FK reading ease and FK grade level (Kincaid et al. 1975). The formula for FK reading ease is:

206.835 - 1.015 × (average number of words per sentence) - 84.6 × (average number of syllables per word)

This measurement determines how easy or difficult a text is for an individual to comprehend, with higher measurements corresponding to an easier ability to comprehend a given text and lower measurements corresponding to a worse ability to comprehend a given text. This measurement can be interpreted using the following guidelines:

0-29: Very difficult (postgraduate)

30-49: Difficult (college)

50-59: Fairly difficult (high school)

60-69: Standard (8th to 9th grade)

70-79: Fairly easy (7th grade)

80-89: Easy (5th to 6th grade)

90-100: Very easy (4th to 5th grade)

The formula for FK grade level is:

0.39 × (average number of words per sentence) + 11.8 × (average number of syllables per word) – 15.59

The FK grade level measurement corresponds to the grade level the individual reading the text must have completed to fully comprehend that text. Measurements are rounded either up or down. Websites that receive an FK grade level score that ends in a decimal of 0.4 or lower are rounded down to the nearest grade level. Likewise, websites that receive an FK grade level score that ends in a decimal of 0.5 or higher are rounded up to the nearest grade level. For example, an FK grade level measurement of 10.4 requires the reader to have a tenth-grade reading level to understand the website material, while an FK grade level measurement of 7.6 requires the reader to have an eighth-grade reading level to understand the reading material.

To better comprehend the understandability and actionability of the available patient education materials regarding common orthopaedic trauma conditions, the PEMAT was used. This is a highly validated tool and systematic method used to legitimize the literacy of available printed and audiovisual educational materials (Shoemaker, Wolf, and Brach 2014). Only printable website materials can be assessed using the PEMAT, therefore only these materials were rated in the current study. Both the understandability and actionability section of the PEMAT was rated by two independent reviewers. They answered a series of questions about the educational material they reviewed, with more understandable and more actionable websites receiving a higher percentage score. A high actionability score indicates a website is likely very useful for patients, who can identify next steps and take action based on the information presented within a given online material.

RESULTS

The Flesch-Kincaid reading ease, Flesch-Kincaid grade level, PEMAT understandability score, and PEMAT actionability score of each website analyzed is listed in *Table 1*. The mean Flesch-Kincaid reading ease, Flesch-Kincaid grade level, PEMAT understandability score, and PEMAT actionability score of each orthopaedic trauma condition is provided in *Table 2*. The average FK reading ease of the orthopaedic trauma conditions analyzed is displayed in *Figure 1*, while the average FK grade level of these conditions is displayed in *Figure 2*. The average FK reading ease of all 32 conditions combined was 47.9, which correlates with "difficulty (college)". The average FK grade level of all 32 conditions combined was 8.7, a score which requires a 9th grade reading level to understand the educational materials. Websites discussing pelvic fractures had the highest FK reading ease, with an average of 57, corresponding with "fairly difficult (high school)". Websites discussing periprosthetic femur fractures had the lowest FK reading ease, with an average of 37.3, corresponding to "difficult (college)". Websites on talus fractures had the lowest average FK grade level, 7.6, while websites discussing periprosthetic distal femur fractures had the highest average FK grade level, 10.5. None of the fifty websites analyzed had FK reading ease scores at or above 70, meaning no website was at or below a 7th grade level. The average PEMAT understandability score was 85. The average PEMAT actionability score was much lower at 48.

Table 3 presents the number of times the websites of several organizations or institutions were represented in an Internet search for the top five websites on a particular orthopaedic injury. The five organization or institutions represented most often are included.

Table 4 presents the top five websites for each condition searched, as well the name of the organization or practice analyzed and the website link.

DISCUSSION

This is the first study to assess the readability, actionability, and understandability of the most common orthopaedic trauma conditions. All 32 conditions listed on the OTA website were scored and evaluated. The condition with the highest mean FK reading ease was pelvis fracture (57.0), while the condition with the lowest mean FK reading ease was periprosthetic distal femur fracture (37.3). The average overall FK reading ease was 47.9, which is far below the recommended FK reading ease of 80.0 or higher. The condition with the highest mean FK grade level was periprosthetic distal femur fractures (10.5), while the condition with the lowest mean FK grade level was talus fractures (7.6). The average overall FK grade level was 8.7. This is much higher than the recommended FK grade level of 6.4 or lower, which would correlate with a score at or below a sixth grade level. Only two websites (1.25%) scored an FK reading ease at or below that of a sixth grading reading level. These websites included one on young patients with femoral neck fractures and one on pelvis fractures. A total of six websites (3.75%) had an FK grade level at or below a sixth-grade reading level. These websites included information regarding clavicle fractures, radial head fractures, young patients with femoral neck fractures, pelvis fractures, geriatric femoral neck fractures, and metatarsal fractures. The average over-

Table 2. Mean Flesch-Kincaid reading ease, Flesch-Kincaid grade level, PEMAT understandability score, and PEMAT actionability score of each orthopaedic trauma condition analyzed and number of websites graded to be at or below a 6th grade level.

Google search condition	FK Reading Ease and Correlation	FK Grade Level	PEMAT Understandability (%)	PEMAT Actionability (%)	Number of websites graded at or below a 6th grade level
Scapula Fracture	43.0 ± 13.8; “difficult (college)”	9.3 ± 2.0	84.9 ± 10.4	30.0 ± 14.1	0
Shoulder Dislocation with Fracture	48.6 ± 9.0; “difficult (college)”	8.3 ± 1.1	91.5 ± 3.3	68.0 ± 22.8	0
Proximal Humerus Fracture	41.3 ± 11.1; “difficult (college)”	9.5 ± 1.8	86.6 ± 7.0	44.0 ± 8.9	0
Humeral Shaft Fracture	45.1 ± 8.0; “difficult (college)”	9.3 ± 1.6	86.7 ± 4.6	44.0 ± 16.7	0
Clavicle Fracture	54.0 ± 9.3; “fairly difficult (high school)”	8.0 ± 1.6	91.1 ± 4.3	52.0 ± 17.9	1
Distal Humerus Fracture	40.4 ± 18.2; “difficult (college)”	9.1 ± 1.9	82.7 ± 8.9	40.0 ± 28.3	0
Olecranon Fracture	45.6 ± 11.6; “difficult (college)”	9.3 ± 1.3	76.6 ± 12.0	36.0 ± 26.1	0
Radial Head Fracture	46.6 ± 13.0; “difficult (college)”	8.4 ± 1.5	79.5 ± 8.0	32.0 ± 17.9	1
Elbow Dislocation	49.3 ± 10.6; “difficult (college)”	8.5 ± 1.1	81.8 ± 12.4	36.0 ± 16.7	0
Broken and Dislocated Elbows	48.3 ± 9.6; “difficult (college)”	8.2 ± 78.3	88.0 ± 8.2	48.0 ± 17.9	0
Forearm Fracture	53.5 ± 13.8; “fairly difficult (high school)”	8.7 ± 2.4	85.4 ± 14.0	40.0 ± 20.0	0
Distal Radius Fracture	46.3 ± 13.7; “difficult (college)”	10.4 ± 3.2	87.0 ± 9.2	32.0 ± 17.9	0
Posterior Wall Acetabular Fracture	45.6 ± 10.3; “difficult (college)”	8.6 ± 0.9	82.4 ± 9.5	40.0 ± 20.0	0
Young Patients with Femoral Neck Fracture	51.6 ± 19.2; “fairly difficult (high school)”	8.2 ± 4.2	84.0 ± 7.4	20.0 ± 0.0	1
Periprosthetic Hip Fracture	46.9 ± 5.9; “difficult (college)”	8.7 ± 0.8	85.2 ± 9.5	32.0 ± 17.9	0
Pelvis Fracture	57.0 ± 20.6; “fairly difficult (high school)”	7.9 ± 3.4	86.3 ± 7.8	44.0 ± 16.7	1
Femoral Head Fracture	48.5 ± 7.8; “difficult (college)”	8.5 ± 1.1	85.2 ± 8.3	28.0 ± 11.0	0
Acetabular Fracture	43.8 ± 7.6; “difficult (college)”	9.1 ± 1.4	86.2 ± 11.5	48.0 ± 22.8	0

Google search condition	FK Reading Ease and Correlation	FK Grade Level	PEMAT Understandability (%)	PEMAT Actionability (%)	Number of websites graded at or below a 6th grade level
Intertrochanteric Fracture	45.5 ± 9.1; "difficult (college)"	8.5 ± 1.6	78.8 ± 13.0	42.0 ± 13.0	0
Geriatric Femoral Neck Fractures	47.9 ± 21.0; "difficult (college)"	7.9 ± 3.1	90.0 ± 3.5	64.0 ± 15.2	1
Periprosthetic Distal Femur Fracture	37.3 ± 15.0; "difficult (college)"	10.5 ± 3.6	79.8 ± 14.9	58.0 ± 24.9	0
Femoral Shaft Fracture	49.0 ± 10.4; "difficult (college)"	8.7 ± 1.1	86.2 ± 8.1	68.0 ± 11.0	0
Distal Femur Fracture	51.9 ± 10.1; "fairly difficult (high school)"	8.3 ± 1.4	88.2 ± 4.8	62.0 ± 17.9	0
Patella Fracture	52.2 ± 10.4; "fairly difficult (high school)"	8.5 ± 2.0	87.7 ± 6.0	60.0 ± 14.1	0
Knee Dislocation	39.6 ± 12.9; "difficult (college)"	9.2 ± 1.8	81.9 ± 8.2	52.0 ± 16.4	0
Tibial Plateau Fracture	41.4 ± 17.8; "difficult (college)"	10.3 ± 3.6	84.8 ± 7.0	48.0 ± 11.0	0
Pilon Fracture	51.6 ± 15.5; "fairly difficult (high school)"	8.6 ± 1.2	87.8 ± 8.5	64.0 ± 16.7	0
Ankle Fracture	53.0 ± 9.6; "fairly difficult (high school)"	8.0 ± 1.1	89.5 ± 5.2	62.0 ± 11.0	0
Tibial Shaft Fracture	44.8 ± 11.5; "difficult (college)"	9.3 ± 1.4	89.2 ± 6.4	54.0 ± 16.7	0
Talus Fracture	56.6 ± 9.6; "fairly difficult (high school)"	7.6 ± 1.4	80.4 ± 6.4	66.0 ± 13.4	0
Calcaneus Fracture	46.1 ± 13.6; "difficult (college)"	9.4 ± 1.6	82.6 ± 5.4	52.0 ± 22.8	0
Metatarsal Fracture	52.6 ± 9.3; "fairly difficult (high school)"	7.8 ± 1.5	84.2 ± 6.4	56.7 ± 17.9	1
Lisfranc Injury	54.9 ± 9.2; "fairly difficult (high school)"	7.7 ± 0.7	81.0 ± 10.4	52.0 ± 22.8	0
Overall mean for all conditions	47.9 ± 12.4; "difficult (college)"	8.7 ± 1.9	85 ± 8.6	48 ± 20.4	n/a

Legend. Flesh-Kincaid, FK; Patient Education Materials Assessment Tool, PEMAT; not applicable, n/a

all PEMAT understandability for all articles was 85.0, while the average overall PEMAT actionability score was 48.0.

Poor readability of educational materials recommended to patients is not an issue that only affects orthopedic trauma, but many subspecialties within orthopedics. Abdullah et al. discovered online patient education materials regarding common orthopedic sports medicine injuries were written at a difficulty that far exceeded that which is recommended by the AMA and NIH (Abdullah et al. 2022), mirroring the results of the current study. Additionally, Luciani et al., an article evaluating the materials on orthopedic spine procedures and conditions, found the readability of materials to also be exceedingly high (Luciani et al. 2022). Besides these two studies, there are many other papers evaluating readability across orthopedic surgery

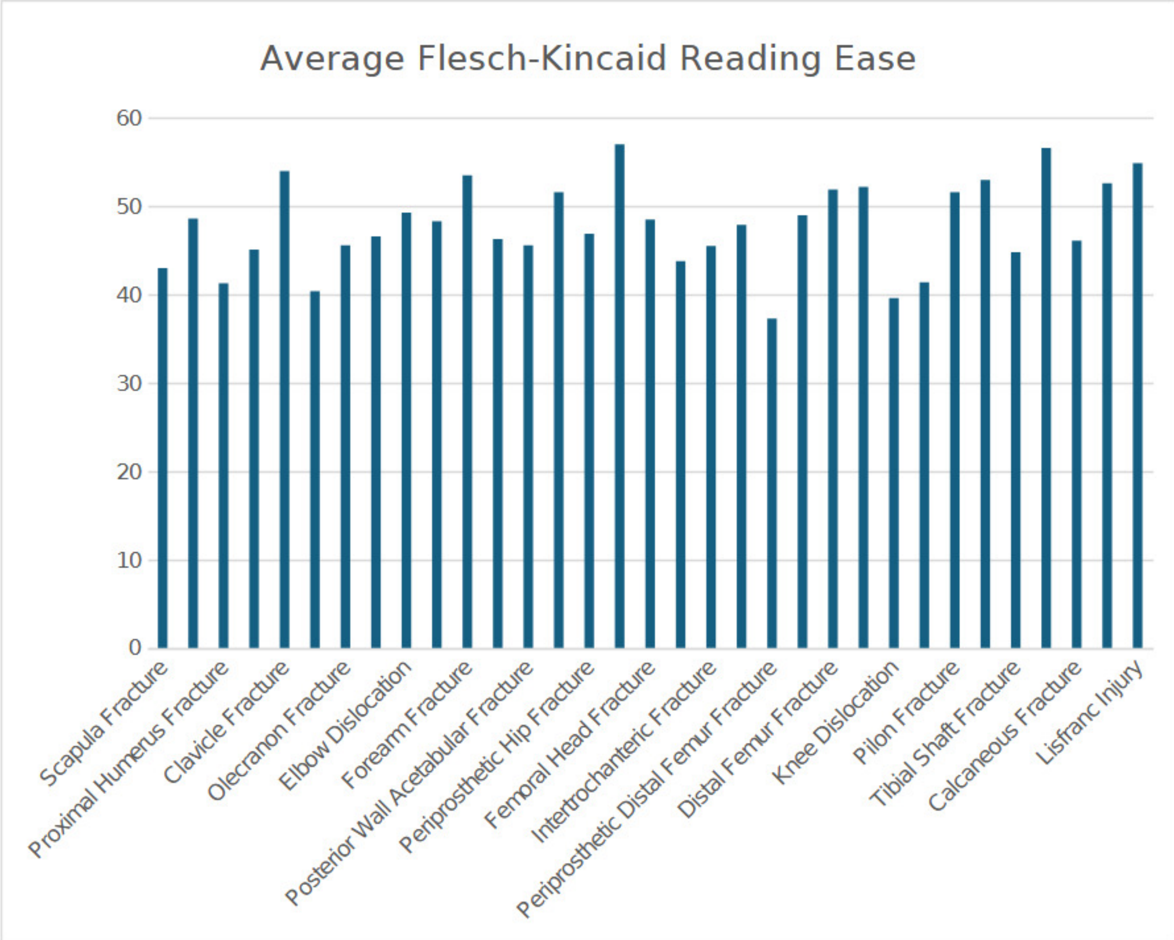

Figure 1. Average Flesch-Kincaid reading ease for each orthopaedic trauma condition.

(Ghanem et al. 2023; Akinleye et al. 2018; Badarudeen and Sabharwal 2010; Baumann et al. 2023).

A study published in 2010 is arguably one of the first articles addressing the importance of readability and health informatics within orthopedic surgery (Badarudeen and Sabharwal 2010). At the time this article was published, the majority of available orthopedic patient educational materials were not written at recommended reading levels. Therefore, the authors recommended a system to maximize comprehension: stratifying patient educational materials to provide materials written at different levels of complexity. While this may be a potential solution to addressing the issue of poor readability, it may further complicate the issue at hand for both patients and physicians.

Several suggestions to improve readability and understandability of orthopedic educational materials include the addition of audiovisual aids, a change in the format of current materials, and modifying materials to remove medical jargon. Audiovisual aids, such as video clips and pictures (Bass 2005; Dahodwala et al. 2018; Schubbe, Cohen, Yen, et al. 2018), can greatly enhance patient understanding of otherwise complex topics. Altering the way in which current educational materials are written for patients is another way to fix this problem. Baumann et al. found that by reducing sentence length to under 15 words per sentence in addition to reducing the amount of complex words, readability was improved (Baumann et al. 2023). Other ways educational materials may be altered include adopting the use of conversational style when writing, avoiding ambiguous words, and using analogies that are familiar with the target audience (Badarudeen and Sabharwal 2010). Removing medical jargon from educational material meant for patients has also shown to enhance patient understanding of medical conditions by decreasing confusion (Badarudeen and Sabharwal 2010; Gotlieb, Praska, Hendrickson, et al. 2022).

To further address this issue, orthopedic surgeons may elect to develop a site where they can easily locate educational materials to recommend to their patients that have been pre-screening for readability, understandability, and actionability. Creating this reservoir, whether in the form of a website or a list of links or pamphlets that can be shared with patients during their appointment, is perhaps the most direct way orthopedic surgeons can tackle poor health literacy nationwide. Additionally, the tools used in this study may be used by orthopedic surgeon to come to a quick conclusion over whether to recommend a material to a patient.

As research shows a patient's health literacy is often considered the most important and most valuable predictor of their health status, readability is a topic all orthopedic surgeons should be made aware of (Weiss 2007; Baker et

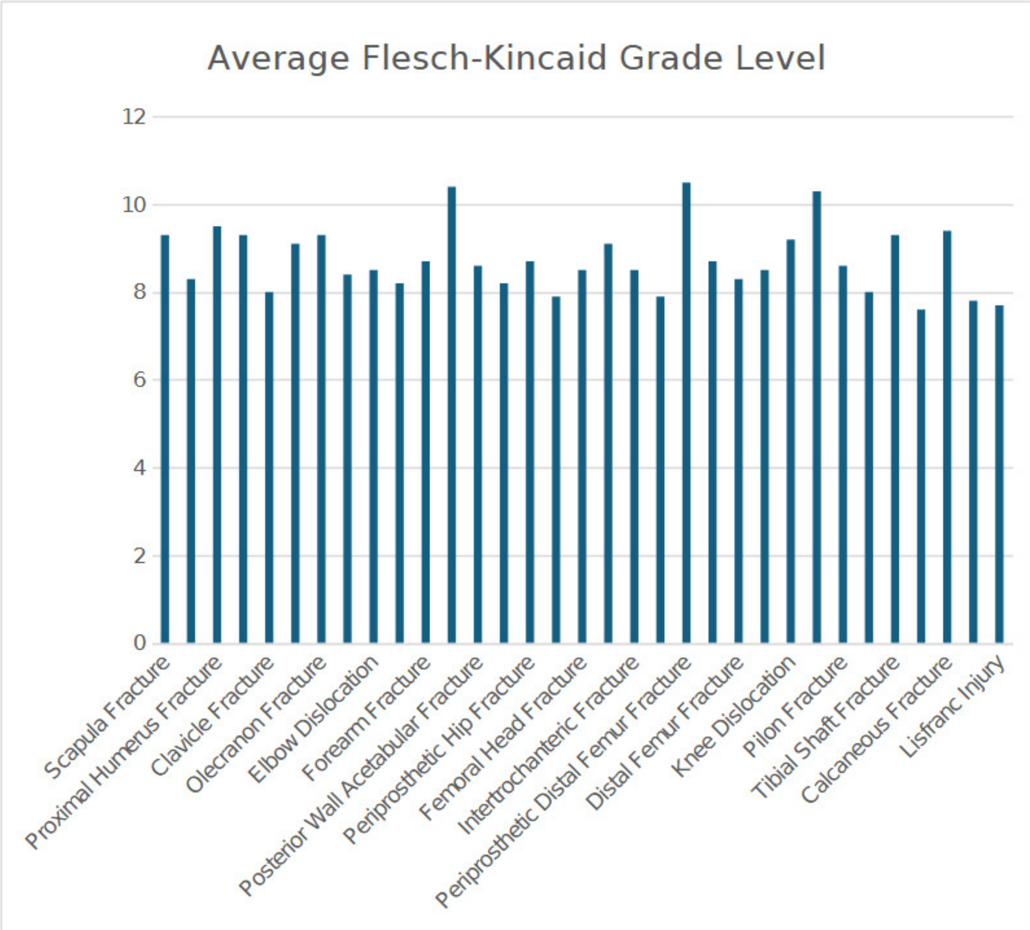

Figure 2. Average Flesch-Kincaid grade level for each orthopaedic trauma condition.

Table 3. Top five organizations or institutions represented among all Google search conditions for the orthopaedic injuries reviewed in this study.

Organization or Institution	Number of Appearances in the Top Five Websites for an Orthopaedic Condition
National Institutes of Health (NIH)	33
Orthobullets	27
American Academy of Orthopaedic Surgeons (AAOS)	25
Orthopaedic Trauma Association (OTA)	17
Cleveland Clinic	10

al. 1997; Johnson and Weiss 2008). This article will hopefully equip orthopedic trauma surgeons with information on the current state of readability within their field and equip them with the tools to improve the care and health outcomes of their patients.

LIMITATIONS

This study is not without limitations. Patients seeking information on orthopaedic trauma conditions and procedures may encounter variability in the results of their search depending on their search engine history, which is used by an algorithm to recommend websites the patient may prefer. The Google search engine was utilized to conduct this study. While patient may elect to use other search engines, such as Bing, Yahoo, or DuckDuckGo, these may provide a different set of search results. Future studies be conducted to evaluate results from various search engines patient may use to seek information regarding their orthopaedic condition. Future studies should also analyze whether certain types of organizations (i.e., academic hospitals, private surgeon websites, professional organizations) consistently produce more readable content. This was not evaluated within the current study due to a widespread lack of readability. Additionally, this study does not account for differences in reading level based on socioeconomic status and region, as it is meant to provide an overview of readability applicable to the general public.

CONCLUSION

Most patient educational materials related to orthopedic trauma procedures are written at a level that far exceeds that of the reading levels recommended by national medical organizations. To combat this, orthopedic surgeons should be equipped with the right resources to better analyze educational materials prior to recommending them to patients. Future studies should be conducted to evaluate how our recommendations on improve readability affect patient outcomes in the short-term and long-term postoperatively.

Submitted: December 11, 2024 EDT. Accepted: March 11, 2025 EDT. Published: July 20, 2025 EDT.

REFERENCES

Abdullah, Y., A. Alokozai, S. O'Connell, and M.K. Mulcahey. 2022. "Online Patient Education Materials for Common Sports Injuries Are Written at Too-High of a Reading Level: A Systematic Review." *Arthroscopy, Sports Medicine, and Rehabilitation* 4 (3): e861–75. https://doi.org/10.1016/j.asmr.2021.12.017.

Akinleye, S. D., R. Krochak, N. Richardson, G. Garofolo, M. D. Culbertson, and O. Erez. 2018. "Readability of the Most Commonly Accessed Arthroscopy-Related Online Patient Education Materials." *Arthroscopy: The Journal of Arthroscopic & Related Surgery* 34 (4): 1272–79. https://doi.org/10.1016/j.arthro.2017.09.043.

Badarudeen, S., and S. Sabharwal. 2010. "Assessing Readability of Patient Education Materials: Current Role in Orthopaedics." *Clinical Orthopaedics & Related Research* 468 (10): 2572–80. https://doi.org/10.1007/s11999-010-1380-y.

Baker, D. W., R. M. Parker, M. V. Williams, W. S. Clark, and J. Nurss. 1997. "The Relationship of Patient Reading Ability to Self-Reported Health and Use of Health Services." *Am J Public Health* 87 (6): 1027–30. https://doi.org/10.2105/AJPH.87.6.1027.

Bass, L. 2005. "Health Literacy: Implications for Teaching the Adult Patient." *Journal of Infusion Nursing* 28 (1): 15–22. https://doi.org/10.1097/00129804-200501000-00002.

Baumann, J., S. Marshall, A. Groneck, S.J. Hanish, T. Choma, and S. DeFroda. 2023. "Readability of Spine-Related Patient Education Materials: A Standard Method for Improvement." *Eur Spine J* 32 (9): 3039–46. https://doi.org/10.1007/s00586-023-07856-5.

Cohen, R., and P. Adams. 2011. "Use of the Internet for Health Information: United States,2009." *NCHS Data Brief*, 1–8.

Dahodwala, M., R. Geransar, J. Babion, J. De Grood, and P. Sargious. 2018. "The Impact of the Use of Video-Based Educational Interventions on Patient Outcomes in Hospital Settings: A Scoping Review." *Patient Education and Counseling* 101 (12): 2116–24. https://doi.org/10.1016/j.pec.2018.06.018.

Daraz, L., J. C. MacDermid, S. Wilkins, and L. Shaw. 2009. "Tools to Evaluate the Quality of Web Health Information: A Structured Review of Content and Usability." *The International Journal of Technology, Knowledge, and Society* 5 (3): 127–42. https://doi.org/10.18848/1832-3669/CGP/v05i03/55997.

Daraz, L., A. S. Morrow, O. J. Ponce, et al. 2018. "Readability of Online Health Information: A Meta-Narrative Systematic Review." *Am J Med Qual* 33 (5): 487–92. https://doi.org/10.1177/1062860617751639.

Finney Rutten, L. J., K. D. Blake, A. J. Greenberg-Worisek, S. V. Allen, R. P. Moser, and B. W. Hesse. 2019. "Online Health Information Seeking Among US Adults: Measuring Progress Toward a Healthy People 2020 Objective." *Public Health Rep* 134 (6): 617–25. https://doi.org/10.1177/0033354919874074.

Ghanem, D., O. Covarrubias, A.B. Harris, and B. Shafiq. 2023. "Readability of the Orthopaedic Trauma Association Patient Education Tool." *Journal of Orthopaedic Trauma* 37 (8): e307–11. https://doi.org/10.1097/BOT.0000000000002593.

Gotlieb, R., C. Praska, M. A. Hendrickson, et al. 2022. "Accuracy in Patient Understanding of Common Medical Phrases." *JAMA Netw Open* 5 (11): e2242972. https://doi.org/10.1001/jamanetworkopen.2022.42972.

Hautala, G. S., S. M. Comadoll, M. L. Raffetto, et al. 2021. "Most Orthopaedic Trauma Patients Are Using the Internet, but Do You Know Where They're Going?" *Injury* 52 (11): 3299–3303. https://doi.org/10.1016/j.injury.2021.02.029.

Hirsch, M., S. Aggarwal, C. Barker, C. J. Davis, and J. M. N. Duffy. 2017. "Googling Endometriosis: A Systematic Review of Information Available on the Internet." *Am J Obstet Gynecol* 216 (5): 451-458.e1. https://doi.org/10.1016/j.ajog.2016.11.1007.

Jarman, M. P., M. J. Weaver, A. H. Haider, A. Salim, and M. B. Harris. 2020. "The National Burden of Orthopedic Injury: Cross-Sectional Estimates for Trauma System Planning and Optimization." *Journal of Surgical Research* 249:197–204. https://doi.org/10.1016/j.jss.2019.12.023.

Johnson, K., and B.D. Weiss. 2008. "How Long Does It Take to Assess Literacy Skills in Clinical Practice?" *The Journal of the American Board of Family Medicine* 21 (3): 211–14. https://doi.org/10.3122/jabfm.2008.03.070217.

Kincaid, J., R. Fishburne, R. Rogers, and B. Chissom. 1975. "Derivation Of New Readability Formulas (Automated Readability Index, Fog Count And Flesch Reading Ease Formula) For Navy Enlisted Personnel.," 49. https://doi.org/10.21236/ADA006655.

Luciani, A. M., B. K. Foster, D. Hayes, and E. M. DelSole. 2022. "Readability of Online Spine Patient Education Resources." *World Neurosurgery* 162:e640–44. https://doi.org/10.1016/j.wneu.2022.03.091.

Rooney, M. K., G. Santiago, S. Perni, et al. 2021. "Readability of Patient Education Materials From High-Impact Medical Journals: A 20-Year Analysis." *Journal of Patient Experience* 8:237437352199884. https://doi.org/10.1177/2374373521998847.

Schubbe, D., S. Cohen, R. W. Yen, et al. 2018. "Does Pictorial Health Information Improve Health Behaviours and Other Outcomes? A Systematic Review Protocol." *BMJ Open* 8 (8): e023300. https://doi.org/10.1136/bmjopen-2018-023300.

Shoemaker, S. J., M. S. Wolf, and C. Brach. 2014. "Development of the Patient Education Materials Assessment Tool (PEMAT): A New Measure of Understandability and Actionability for Print and Audiovisual Patient Information." *Patient Education and Counseling* 96 (3): 395–403. https://doi.org/10.1016/j.pec.2014.05.027.

Wang, X., and R. A. Cohen. 2023. "Health Information Technology Use Among Adults: United States, July–December 2022." October 2023. https://doi.org/10.15620/cdc:133700.

Weiss, B. 2007. *Health Literacy and Patient Safety: Help Patients Understand. Manual for Clinicians*.

SUPPLEMENTARY INDEX TABLES

Table 1. Flesch-Kincaid reading ease, Flesch-Kincaid grade level, PEMAT understandability scores, and PEMAT actionability scores of the top five websites for each orthopaedic trauma condition analyzed.

	Google search condition	FK Reading Ease	FK Grade Level	PEMAT Understandability (%)	PEMAT Actionability (%)
1	Scapula Fracture	51.8	9.5	80.0	40.0
2	Scapula Fracture	51.9	8	93.8	20.0
3	Scapula Fracture	24	12.3	87.5	10.0
4	Scapula Fracture	32.7	9.5	69.2	40.0
5	Scapula Fracture	54.7	7.1	93.8	40.0
1	Shoulder Dislocation with Fracture	54.8	7.5	93.8	60.0
2	Shoulder Dislocation with Fracture	46.7	8.8	93.8	40.0
3	Shoulder Dislocation with Fracture	60.8	6.9	94.1	100.0
4	Shoulder Dislocation with Fracture	40.7	9.8	87.5	60.0
5	Shoulder Dislocation with Fracture	40.1	8.5	88.2	80.0
1	Proximal Humerus Fracture	45.9	11.2	90.0	40.0
2	Proximal Humerus Fracture	29.9	9.9	86.7	40.0
3	Proximal Humerus Fracture	52.9	7.7	93.3	60.0
4	Proximal Humerus Fracture	29.1	11.2	75.0	40.0
5	Proximal Humerus Fracture	48.9	7.7	88.2	40.0
1	Humeral Shaft Fracture	45.9	11.2	83.3	40.0
2	Humeral Shaft Fracture	41.5	8.5	84.6	20.0
3	Humeral Shaft Fracture	34.2	10.7	83.3	40.0
4	Humeral Shaft Fracture	55.6	7.4	94.1	60.0
5	Humeral Shaft Fracture	48.3	8.7	88.2	60.0
1	Clavicle Fracture	40.1	9.7	83.3	40.0
2	Clavicle Fracture	59.5	7.1	94.1	80.0
3	Clavicle Fracture	59.7	9.6	92.3	40.0
4	Clavicle Fracture	48.6	7.5	92.3	40.0
5	Clavicle Fracture	61.9	6.2	93.3	60.0
1	Distal Humerus Fracture	60.6	7.3	93.3	80.0
2	Distal Humerus Fracture	38.3	8.7	82.4	20.0
3	Distal Humerus Fracture	27.8	10.1	69.2	20.0
4	Distal Humerus Fracture	56.8	7.4	87.5	60.0
5	Distal Humerus Fracture	18.3	11.9	81.3	20.0
1	Olecranon Fracture	38.6	10.1	61.5	20.0
2	Olecranon Fracture	60.5	7.1	93.3	80.0
3	Olecranon Fracture	54.6	10.6	76.9	20.0
4	Olecranon Fracture	32.5	9.4	70	20.0
5	Olecranon Fracture	41.6	9.2	81.3	40.0
1	Radial Head Fracture	55	7.6	87.5	40.0
2	Radial Head Fracture	30.9	9.9	70.0	20.0
3	Radial Head Fracture	44.9	8.4	75.0	20.0
4	Radial Head Fracture	38.5	9.8	76.8	20.0
5	Radial Head Fracture	63.6	6.4	88.2	60.0
1	Elbow Dislocation	54.2	8	87.5	40.0
2	Elbow Dislocation	38.9	8.7	81.3	20.0
3	Elbow Dislocation	37.1	10.4	61.4	20.0

Google search condition		FK Reading Ease	FK Grade Level	PEMAT Understandability (%)	PEMAT Actionability (%)
4	Elbow Dislocation	55.5	7.6	84.6	60.0
5	Elbow Dislocation	60.6	7.8	94.1	40.0
1	Broken and Dislocated Elbows	56.3	7.3	94.1	60.0
2	Broken and Dislocated Elbows	36.8	9.2	84.6	40.0
3	Broken and Dislocated Elbows	55.5	7.6	92.3	60.0
4	Broken and Dislocated Elbows	38.9	8.7	75.0	20.0
5	Broken and Dislocated Elbows	54.2	8	93.8	60.0
1	Forearm Fracture	59.3	7.4	93.8	60.0
2	Forearm Fracture	29.1	12	61.4	20.0
3	Forearm Fracture	59	7	93.8	20.0
4	Forearm Fracture	62.7	6.6	93.8	60.0
5	Forearm Fracture	57.3	10.3	84.6	40.0
1	Distal Radius Fracture	63.6	8.6	93.8	40.0
2	Distal Radius Fracture	58.2	7.8	93.8	60.0
3	Distal Radius Fracture	39.9	10.7	76.9	20.0
4	Distal Radius Fracture	37.4	8.9	76.9	20.0
5	Distal Radius Fracture	32.4	15.8	93.8	20.0
1	Posterior Wall Acetabular Fracture	48.3	8.7	84.6	60.0
2	Posterior Wall Acetabular Fracture	43	8	70.6	20.0
3	Posterior Wall Acetabular Fracture	54.7	7.7	88.2	40.0
4	Posterior Wall Acetabular Fracture	52.8	8.5	93.8	60.0
5	Posterior Wall Acetabular Fracture	29.1	10.1	75.0	20.0
1	Young Patients with Femoral Neck Fracture	48.5	8.7	81.3	20.0
2	Young Patients with Femoral Neck Fracture	48	8.7	75.0	20.0
3	Young Patients with Femoral Neck Fracture	83.1	2.5	94.1	20.0
4	Young Patients with Femoral Neck Fracture	30.6	14.1	81.3	20.0
5	Young Patients with Femoral Neck Fracture	48	7.1	88.3	20.0
1	Periprosthetic Hip Fracture	52	7.7	93.8	40.0
2	Periprosthetic Hip Fracture	38.4	8.7	88.3	20.0
3	Periprosthetic Hip Fracture	53	8	93.8	60.0
4	Periprosthetic Hip Fracture	44.9	9.5	75.0	20.0
5	Periprosthetic Hip Fracture	46.1	9.5	75.0	20.0
1	Pelvis Fracture	57.3	9.7	84.6	60.0
2	Pelvis Fracture	57.8	7.9	84.6	40.0
3	Pelvis Fracture	54.8	7.9	93.8	60.0
4	Pelvis Fracture	28.2	11.5	75.0	20.0
5	Pelvis Fracture	86.7	2.3	93.8	20.0
1	Femoral Head Fracture	47.7	8.7	75.0	20.0

Google search condition		FK Reading Ease	FK Grade Level	PEMAT Understandability (%)	PEMAT Actionability (%)
2	Femoral Head Fracture	41.3	8.3	81.3	20.0
3	Femoral Head Fracture	40.7	10.2	82.4	20.0
4	Femoral Head Fracture	55.3	7.3	93.8	40.0
5	Femoral Head Fracture	57.7	7.9	93.8	40.0
1	Acetabular Fracture	52.8	8.5	85.7	80.0
2	Acetabular Fracture	48.3	8.7	90.9	60.0
3	Acetabular Fracture	43	8	66.7	20.0
4	Acetabular Fracture	32.4	11.6	95.8	40.0
5	Acetabular Fracture	42.7	8.9	91.7	40.0
1	Intertrochanteric Fracture	34.5	10.6	62.5	20.0
2	Intertrochanteric Fracture	45.6	7.6	87.5	50.0
3	Intertrochanteric Fracture	55.2	7.2	93.8	40.0
4	Intertrochanteric Fracture	38.5	10	81.3	50.0
5	Intertrochanteric Fracture	53.6	7.3	68.8	50.0
1	Geriatric Femoral Neck Fractures	49.1	8.1	86.7	60.0
2	Geriatric Femoral Neck Fractures	44.7	9.2	87.5	80.0
3	Geriatric Femoral Neck Fractures	48	7.4	87.5	50.0
4	Geriatric Femoral Neck Fractures	78.5	3.2	93.8	80.0
5	Geriatric Femoral Neck Fractures	19.2	11.7	93.3	50.0
1	Periprosthetic Distal Femur Fracture	30.6	11.1	93.3	80.0
2	Periprosthetic Distal Femur Fracture	30.4	9.8	81.3	50.0
3	Periprosthetic Distal Femur Fracture	62.6	6.6	87.5	60.0
4	Periprosthetic Distal Femur Fracture	24.6	16.1	54.5	20.0
5	Periprosthetic Distal Femur Fracture	38.3	8.7	82.4	80.0
1	Femoral Shaft Fracture	58.5	7.4	93.8	60.0
2	Femoral Shaft Fracture	34.6	9.2	76.5	60.0
3	Femoral Shaft Fracture	41.6	9.6	79.0	80.0
4	Femoral Shaft Fracture	56.3	7.6	88.2	80.0
5	Femoral Shaft Fracture	53.8	9.5	93.8	60.0
1	Distal Femur Fracture	62.9	7.3	94.7	60.0
2	Distal Femur Fracture	42.8	7.9	87.5	50.0
3	Distal Femur Fracture	40.1	9.8	81.3	40.0
4	Distal Femur Fracture	54.3	9.7	89.5	80.0
5	Distal Femur Fracture	59.5	6.7	88.2	80.0
1	Patella Fracture	51.3	11.7	82.4	60.0
2	Patella Fracture	61.3	6.9	94.1	80.0
3	Patella Fracture	58.9	7.4	93.3	60.0
4	Patella Fracture	34.8	9.3	81.3	40.0
5	Patella Fracture	54.5	7.4	87.5	60.0
1	Knee Dislocation	26.7	11.6	75.0	50.0
2	Knee Dislocation	41.4	9	84.2	40.0

Google search condition		FK Reading Ease	FK Grade Level	PEMAT Understandability (%)	PEMAT Actionability (%)
3	Knee Dislocation	30.7	9.9	82.4	50.0
4	Knee Dislocation	59.9	6.8	94.1	80.0
5	Knee Dislocation	39.1	8.6	73.7	40.0
1	Tibial Plateau Fracture	62.4	6.5	89.5	60.0
2	Tibial Plateau Fracture	39.8	8.4	76.5	40.0
3	Tibial Plateau Fracture	35	10.6	80.0	40.0
4	Tibial Plateau Fracture	53.7	9.9	93.8	60.0
5	Tibial Plateau Fracture	16.3	16.1	84.2	40.0
1	Pilon Fracture	65.4	8.2	87.5	80.0
2	Pilon Fracture	59.9	7.4	94.1	80.0
3	Pilon Fracture	30	10	73.7	40.0
4	Pilon Fracture	62.2	7.7	94.7	60.0
5	Pilon Fracture	40.6	9.8	88.9	60.0
1	Ankle Fracture	38	9.8	81.3	60.0
2	Ankle Fracture	56.2	7.6	92.8	80.0
3	Ankle Fracture	58.9	8.2	92.8	50.0
4	Ankle Fracture	49.4	7.4	87.5	60.0
5	Ankle Fracture	62.2	6.8	92.3	60.0
1	Tibial Shaft Fracture	57	7.5	94.4	80.0
2	Tibial Shaft Fracture	29.6	10.2	78.8	50.0
3	Tibial Shaft Fracture	36	10.3	89.5	40.0
4	Tibial Shaft Fracture	52.4	10.3	94.4	60.0
5	Tibial Shaft Fracture	49.1	8.1	88.9	40.0
1	Talus Fracture	59.5	7.3	88.9	80.0
2	Talus Fracture	61.4	6.8	72.2	60.0
3	Talus Fracture	61.8	6.6	81.3	80.0
4	Talus Fracture	60.9	7.4	83.3	60.0
5	Talus Fracture	39.6	10.1	76.5	50.0
1	Calcaneus Fracture	59.9	7.3	88.2	80.0
2	Calcaneus Fracture	31.7	9.8	81.3	40.0
3	Calcaneus Fracture	34.3	11.7	81.3	60.0
4	Calcaneus Fracture	60.2	8.8	75.0	20.0
5	Calcaneus Fracture	44.2	9.2	87.5	60.0
1	Metatarsal Fracture	40.2	9.8	76.5	40.0
2	Metatarsal Fracture	65.6	5.7	83.3	60.0
3	Metatarsal Fracture	48.6	8.5	94.1	83.3
4	Metatarsal Fracture	52.9	7.7	84.6	60.0
5	Metatarsal Fracture	55.6	7.4	82.4	40.0
1	Lisfranc Injury	48.5	7.7	66.7	20.0
2	Lisfranc Injury	60.1	7.5	93.3	80.0
3	Lisfranc Injury	60.1	6.7	80.0	40.0
4	Lisfranc Injury	41.9	8.3	76.5	60.0
5	Lisfranc Injury	63.7	7.7	88.3	60.0

Legend. Flesh-Kincaid, FK; Patient Education Materials Assessment Tool, PEMAT

Table 4. Organizational, institutional, and academic websites analyzed.

Google search condition		Organization/ Institution	Website
1	Scapula Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/scapula-fracture-shoulder-blade-fracture
2	Scapula Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/scapula-shoulder-blade-fractures/
3	Scapula Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK537312
4	Scapula Fracture	Orthobullets	https://www.orthobullets.com/trauma/1013/scapula-fractures
5	Scapula Fracture	Sports Health	https://www.sports-health.com/sports-injuries/shoulder-injuries/broken-shoulder-scapula-fracture
1	Shoulder Dislocation with Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3832
2	Shoulder Dislocation with Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/shoulder-trauma-fractures-and-dislocations
3	Shoulder Dislocation with Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/shoulder-fracture
4	Shoulder Dislocation with Fracture	The Royal Children's Hospital Melbourne	https://www.rch.org.au/clinicalguide/guideline_index/fractures/Shoulder_Dislocations_-_Emergency_Department/
5	Shoulder Dislocation with Fracture	Florida Orthopaedic Institute	https://www.floridaortho.com/specialties/shoulder/shoulder-socket-fracture/
1	Proximal Humerus Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/humerus-fracture-upper-arm-fracture
2	Proximal Humerus Fracture	Orthobullets	https://www.orthobullets.com/trauma/1015/proximal-humerus-fractures
3	Proximal Humerus Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3831
4	Proximal Humerus Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK470346
5	Proximal Humerus Fracture	Radiopaedia	https://radiopaedia.org/articles/proximal-humeral-fracture-1?lang=us
1	Humeral Shaft Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/humerus-fracture-upper-arm-fracture
2	Humeral Shaft Fracture	Orthobullets	https://www.orthobullets.com/trauma/1016/humeral-shaft-fractures
3	Humeral Shaft Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK448074
4	Humeral Shaft Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3731
5	Humeral Shaft Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7845564
1	Clavicle Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK507892
2	Clavicle Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/clavicle-fracture-broken-collarbone/
3	Clavicle Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/clavicle-fractures
4	Clavicle Fracture	Mayo Clinic	https://www.mayoclinic.org/diseases-conditions/broken-collarbone/symptoms-causes/syc-20370311
5	Clavicle Fracture	Nationwide Children's Hospital	https://www.nationwidechildrens.org/conditions/clavicle-fracture
1	Distal Humerus Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/distal-humerus-fractures-of-the-elbow
2	Distal Humerus Fracture	Orthobullets	https://www.orthobullets.com/trauma/1017/distal-humerus-fractures
3	Distal Humerus Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK531474
4	Distal Humerus Fracture	BMC	https://www.bmc.org/patient-care/conditions-we-treat/db/distal-humerus-fracture-broken-elbow
5	Distal Humerus Fracture	Radiopaedia	https://radiopaedia.org/articles/distal-humeral-fracture
1	Olecranon Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK537295
2	Olecranon Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/elbow-olecranon-fractures
3	Olecranon Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/olecranon-fracture-elbow-fracture
4	Olecranon Fracture	Orthobullets	https://www.orthobullets.com/trauma/1022/olecranon-fractures

Google search condition		Organization/ Institution	Website
5	Olecranon Fracture	Medscape	https://emedicine.medscape.com/article/1231557
1	Radial Head Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/radial-head-fractures-of-the-elbow
2	Radial Head Fracture	Orthobullets	https://www.orthobullets.com/trauma/1019/radial-head-fractures
3	Radial Head Fracture	BMC	https://www.bmc.org/patient-care/conditions-we-treat/db/radial-head-fracture
4	Radial Head Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK448140
5	Radial Head Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3733
1	Elbow Dislocation	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/elbow-dislocation/
2	Elbow Dislocation	Orthobullets	https://www.orthobullets.com/trauma/1018/elbow-dislocation
3	Elbow Dislocation	NIH	https://www.ncbi.nlm.nih.gov/books/NBK549817
4	Elbow Dislocation	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/17942-dislocated-elbow
5	Elbow Dislocation	ASSH	https://www.assh.org/handcare/condition/elbow-dislocation
1	Broken and Dislocated Elbows	OTA	https://ota.org/for-patients/find-info-body-part/3715
2	Broken and Dislocated Elbows	TriHealth	https://www.trihealth.com/services/trihealth-orthopedic-and-sports-care/conditions/elbow/fractures-and-dislocations-of-the-elbow
3	Broken and Dislocated Elbows	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/17942-dislocated-elbow
4	Broken and Dislocated Elbows	Orthobullets	https://www.orthobullets.com/trauma/1018/elbow-dislocation
5	Broken and Dislocated Elbows	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/elbow-dislocation
1	Forearm Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/adult-forearm-fractures
2	Forearm Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK574580
3	Forearm Fracture	Boston Children’s Hospital	https://www.childrenshospital.org/conditions/broken-forearm
4	Forearm Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/forearm-fractures-in-children
5	Forearm Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/ulna-and-radius-fractures-forearm-fractures
1	Distal Radius Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/distal-radius-fracture-wrist-fracture
2	Distal Radius Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/distal-radius-fractures-broken-wrist
3	Distal Radius Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK536916
4	Distal Radius Fracture	Orthobullets	https://www.orthobullets.com/trauma/1027/distal-radius-fractures
5	Distal Radius Fracture	HSS	https://www.hss.edu/conditions_distal-radius-fractures-of-the-wrist
1	Posterior Wall Acetabular Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/21917-acetabular-fractures
2	Posterior Wall Acetabular Fracture	Orthobullets	https://www.orthobullets.com/trauma/1034/acetabular-fractures
3	Posterior Wall Acetabular Fracture	OTA	https://ota.org/for-patients/find-info-body-part/4187
4	Posterior Wall Acetabular Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/acetabular-fractures
5	Posterior Wall Acetabular Fracture	Radiopaedia	https://radiopaedia.org/cases/posterior-wall-acetabular-fracture
1	Young Patients with Femoral Neck Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2759588
2	Young Patients with Femoral Neck Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4095012
3	Young Patients with Femoral Neck Fracture	OTA	https://ota.org/sites/files/2021-06/LE%20Hip2%20Femoral%20Neck%20Fx%20Under%2050.pdf
4	Young Patients with Femoral Neck Fracture	University of Pennsylvania	https://www.upoj.org/wp-content/uploads/v20/v20_05.pdf
5	Young Patients with Femoral Neck Fracture	Orthobullets	https://www.orthobullets.com/trauma/1037/femoral-neck-fractures

Google search condition		Organization/ Institution	Website
1	Periprosthetic Hip Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3830
2	Periprosthetic Hip Fracture	Orthobullets	https://www.orthobullets.com/recon/5013/tha-periprosthetic-fracture
3	Periprosthetic Hip Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/fracture-after-total-hip-replacement
4	Periprosthetic Hip Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7845569
5	Periprosthetic Hip Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3598446
1	Pelvis Fracture	Cedars Sinai	https://www.cedars-sinai.org/health-library/diseases-and-conditions/p/pelvic-fracture.html#
2	Pelvis Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/22176-pelvic-fractures
3	Pelvis Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/pelvic-fractures
4	Pelvis Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK430734
5	Pelvis Fracture	Reno Orthopedic Center	https://www.renoortho.com/specialties/center-for-fracture-trauma/pelvis-fracture
1	Femoral Head Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6349681
2	Femoral Head Fracture	Orthobullets	https://www.orthobullets.com/trauma/1036/femoral-head-fractures
3	Femoral Head Fracture	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8631236
4	Femoral Head Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3827
5	Femoral Head Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/hip-fractures
1	Acetabular Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/acetabular-fractures
2	Acetabular Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/21917-acetabular-fractures
3	Acetabular Fracture	Orthobullets	https://www.orthobullets.com/trauma/1034/acetabular-fractures
4	Acetabular Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK544315
5	Acetabular Fracture	Mayo Clinic	https://www.mayoclinic.org/medical-professionals/trauma/news/fractured-repairing-the-acetabulum/mac-20429977
1	Intertrochanteric Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK493161
2	Intertrochanteric Fracture	Orthobullets	https://www.orthobullets.com/trauma/1038/intertrochanteric-fractures
3	Intertrochanteric Fracture	OTA	https://ota.org/for-patients/find-info-body-part/372
4	Intertrochanteric Fracture	Medscape	https://emedicine.medscape.com/article/1247210
5	Intertrochanteric Fracture	Healthline	https://www.healthline.com/health/intertrochanteric-fracture
1	Geriatric Femoral Neck Fractures	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2972258
2	Geriatric Femoral Neck Fractures	NIH	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8887091
3	Geriatric Femoral Neck Fractures	Orthobullets	https://www.orthobullets.com/trauma/1037/femoral-neck-fractures
4	Geriatric Femoral Neck Fractures	OTA	https://ota.org/sites/files/2021-06/Geriatric%20Fx%203%20Femoral%20Neck%20Fracture%20Over%2050.pdf
5	Geriatric Femoral Neck Fractures	Radiopaedia	https://radiopaedia.org/articles/neck-of-femur-fracture
1	Periprosthetic Distal Femur Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK554439/
2	Periprosthetic Distal Femur Fracture	Orthobullets	https://www.orthobullets.com/recon/5027/tka-periprosthetic-fracture
3	Periprosthetic Distal Femur Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3725
4	Periprosthetic Distal Femur Fracture	JB & JS	https://hub.jbjs.org/summary.php?id=160&native=1
5	Periprosthetic Distal Femur Fracture	Orthobullets	https://www.orthobullets.com/recon/5013/tha-periprosthetic-fracture

Google search condition		Organization/ Institution	Website
1	Femoral Shaft Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/femur-shaft-fractures-broken-thighbone
2	Femoral Shaft Fracture	Orthobullets	https://www.orthobullets.com/trauma/1040/femoral-shaft-fractures
3	Femoral Shaft Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK556057
4	Femoral Shaft Fracture	BMC	https://www.bmc.org/patient-care/conditions-we-treat/db/femur-shaft-fracture
5	Femoral Shaft Fracture	Reno Orthopedic Center	https://www.renoortho.com/specialties/center-for-fracture-trauma/femoral-shaft-fractures
1	Distal Femur Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/distal-femur-thighbone-fractures-of-the-knee
2	Distal Femur Fracture	Orthobullets	https://www.orthobullets.com/trauma/1041/distal-femur-fractures
3	Distal Femur Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK551675
4	Distal Femur Fracture	Reno Orthopedic Center	https://www.renoortho.com/specialties/center-for-fracture-trauma/distal-femur-fracture
5	Distal Femur Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3716
1	Patella Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/kneecap-fractures#
2	Patella Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/patellar-kneecap-fractures/
3	Patella Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/22081-patella-fracture
4	Patella Fracture	Orthobullets	https://www.orthobullets.com/trauma/1042/patella-fracture
5	Patella Fracture	BMC	https://www.bmc.org/patient-care/conditions-we-treat/db/patellar-kneecap-fracture
1	Knee Dislocation	NIH	https://www.ncbi.nlm.nih.gov/books/NBK470595
2	Knee Dislocation	Medscape	https://emedicine.medscape.com/article/823589
3	Knee Dislocation	Orthobullets	https://www.orthobullets.com/trauma/1043/knee-dislocation
4	Knee Dislocation	Healthline	https://www.healthline.com/health/dislocated-knee
5	Knee Dislocation	Radiopaedia	https://radiopaedia.org/articles/knee-dislocation
1	Tibial Plateau Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3834
2	Tibial Plateau Fracture	Orthobullets	https://www.orthobullets.com/trauma/1044/tibial-plateau-fractures
3	Tibial Plateau Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK470593
4	Tibial Plateau Fracture	Reno Orthopedic Center	https://www.renoortho.com/specialties/center-for-fracture-trauma/tibial-plateau-fracture
5	Tibial Plateau Fracture	Radiopaedia	https://radiopaedia.org/articles/tibial-plateau-fracture
1	Pilon Fracture	Johns Hopkins	https://www.hopkinsmedicine.org/health/conditions-and-diseases/pilon-fracture-of-the-ankle
2	Pilon Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/pilon-fractures-of-the-ankle
3	Pilon Fracture	Orthobullets	https://www.orthobullets.com/trauma/1046/tibial-plafond-fractures
4	Pilon Fracture	AOFAS	https://www.footcaremd.org/conditions-treatments/ankle/pilon-fracture
5	Pilon Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK482176/
1	Ankle Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK542324
2	Ankle Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/ankle-fractures-broken-ankle
3	Ankle Fracture	HSS	https://www.hss.edu/condition-list_ankle-fractures.asp
4	Ankle Fracture	Mayo Clinic	https://www.mayoclinic.org/diseases-conditions/broken-ankle/symptoms-causes/syc-20450025
5	Ankle Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/21644-broken-ankle
1	Tibial Shaft Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/tibia-shinbone-shaft-fractures
2	Tibial Shaft Fracture	Orthobullets	https://www.orthobullets.com/trauma/1045/tibial-shaft-fractures
3	Tibial Shaft Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK513267
4	Tibial Shaft Fracture	Reno Orthopedic Center	https://www.renoortho.com/specialties/center-for-fracture-trauma/tibial-shaft-fracture
5	Tibial Shaft Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3722
1	Talus Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/talus-fractures
2	Talus Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/22154-talus-fracture

Google search condition		Organization/ Institution	Website
3	Talus Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3833
4	Talus Fracture	AOFAS	https://www.footcaremd.org/conditions-treatments/ankle/talus-fracture
5	Talus Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK539687
1	Calcaneus Fracture	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/calcaneus-heel-bone-fractures
2	Calcaneus Fracture	Orthobullets	https://www.orthobullets.com/trauma/1051/calcaneus-fractures
3	Calcaneus Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK430861
4	Calcaneus Fracture	Cedars Sinai	https://www.cedars-sinai.org/health-library/diseases-and-conditions/c/calcaneal-fracture.html
5	Calcaneus Fracture	The Royal Children's Hospital Melbourne	https://www.rch.org.au/clinicalguide/guideline_index/fractures/Calcaneus_Fractures_-_Emergency_Department/
1	Metatarsal Fracture	NIH	https://www.ncbi.nlm.nih.gov/books/NBK574512
2	Metatarsal Fracture	Medline	https://medlineplus.gov/ency/patientinstructions/000571.htm
3	Metatarsal Fracture	The Royal Children's Hospital Melbourne	https://www.rch.org.au/clinicalguide/guideline_index/fractures/Metatarsal_Foot_Fractures_-_Emergency_Department/
4	Metatarsal Fracture	Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/22247-fifth-metatarsal-fracture
5	Metatarsal Fracture	OTA	https://ota.org/for-patients/find-info-body-part/3723
1	Lisfranc Injury	Mass General Brigham	https://www.massgeneralbrigham.org/en/patient-care/services-and-specialties/sports-medicine/conditions/foot-ankle/lisfranc-injuries
2	Lisfranc Injury	AAOS	https://orthoinfo.aaos.org/en/diseases--conditions/lisfranc-midfoot-injury
3	Lisfranc Injury	ACFAS	https://www.foothealthfacts.org/conditions/lisfranc-injuries
4	Lisfranc Injury	Orthobullets	https://www.orthobullets.com/foot-and-ankle/7030/lisfranc-injury
5	Lisfranc Injury	Cedars Sinai	https://www.cedars-sinai.org/health-library/diseases-and-conditions/l/lisfranc-joint-injury.html

Note. AAOS, American Academy of Orthopaedic Surgeons; NIH, National Institutes of Health; OTA, Orthopaedic Trauma Association; BMC, Boston Medical Center; ASSH, American Society for Surgery of the Hand; HSS, Hospital for Special Surgery; JB & JS, The Journal of Bone and Joint Surgery; AOFAS, The American Orthopaedic Foot and Ankle Society; ACFAS, American College of Foot and Ankle Surgeons