The following evidence table includes literature with a variety of asymptomatic, symptomatic, and random sampling pathological findings for shoulder anatomical changes. Most of the information in this evidence table has been simplified into clinical handouts, *(reference links on UNC DPT capstone website - https://dptcapstone.web.unc.edu/),* however there is additional information that was not utilized in the handouts and might be used for reference.

SHOULDER: Imaging Findings						
Title/Author/Year	Number of Subjects/ Studies	Inclusion/Exclusion	Description of Intervention/Data Synthesis	Outcome Measures/ timeframe	Results	Limitations/Discussion
Bilateral magnetic resonance imaging findings in individuals with unilateral shoulder pain[1] Barreto RPG, Braman JP, Ludewig PM, Ribeiro LP, Camargo PR. 2019[1]	123 individuals with self reported unilateral shoulder pain. (123 symptomatic shoulders and 123 asymptomatic shoulders)	Inclusion: individuals with self-reported unilateral shoulder pain Exclusion: substantial ROM deficit or sign of adhesive capsulitis, upper limb fractures, shoulder dislocations, neck-related pain	MR images obtained in coronal, sagittal, and axial planes. Examined by 2 examiners (orthopedic shoulder surgeon and musculoskeletal radiologist. Absolute and relative frequencies for MRI findings calculated and compared between painful and non-painful shoulder sides. Statistical analysis perofmed with chi-squared with Yates continuity correction was used to compare asympomtatic and symptomatic image findings. Further, Fisher exact test used when expected count was below 5.	Partial thickness tear determined to be present by the discontinuity along superior and inferior surface of extra-articular gap on T2 images. Full thickness tear presented with discontinuity of tendon gap. Images also analyzed for presence of fatty infiltration(stage 1-4), labral lesions, biceps long-head tendinopathy, AC joint alterations, glenohumeral OA and synovitis.	Rotator cuff tendinopathy and AC joint alterations found in both shoulders (~75-90%). Shoulder surgeon reported higher prevalence of full-thickness tears in supraspinatus tendon and glenohumeral OA in symptomatic > asymptomatic shoulders. Radiologist interpretation vssurgeon interpretation. Numbers are averaged in clinical handout. Rotator cuff tendinopathy: 92.7 vs 88.9 Rotator cuff tear: 26.8 vs 20.3 % Full thickness tear: 5.7 vs 1% AC joint path: 91.9% vs 89.4% Labral Alterations: 43.9% vs 41.5% Fatty infiltrations: 20.3 vs 18.7	Imaging analysis was performed by 2 reviewers, 1 orthopedic shoulder surgeon and one musculoskeletal radiologist. Agreement between the two was anywhere from 44-98% depending on the pathology. A more accurate prevalence of findings might be provided with a greater amount of blinded reviewers. One limitation is that an image only captures one single moment, and might not accurately assess the risk of symptom development for asymptomatic shoulders. Results suggest that full-thickness tears may be related to symptoms but that tendinopathy was not found in symptomatic shoulders > asymptomatic. This study provides new information regarding MRI of both shoulders and provided relevant and prevalence data for multiple pathologies not available in other studies. Larger sample sizes might be more appropriate to confirm these findings.

QUALITY	Overall, this study presents with a moderate risk of bias. Bias exists in only have two reviewers of the imaging. Authors indicate that they have adjusted for the risk of bias, however additional bias exists due to lack of blinding of reviewers. Goal of study might have also introduced bias by attempting to meet a certain hypothesis. However, this study does provide novel information regarding multiple pathologies of the shoulder in symptomatic vs asymptomatic shoulders on the same individual. This has not been analyzed in other studies and points to the fact that similar pathology can be found in symptomatic and asymptomatic shoulders. Larger sample sizes might be helpful to confirm this information. See discussion/limitation for specific strengths and limitations within the study.					
Title/Author/Year	Number of Subjects/ Studies	Inclusion/Exclusion	Description of Intervention/Data Synthesis	Outcome Measures/ timeframe	Results	Limitations/Discussion
Symptomatic progression of asymptomatic rotator cuff tears: a prospective study of clinical and sonographic variables [2] Mall NA, Kim HM, Keener JD, et al 2010 [2]	195 subjects with asymptomatic rotator cuff tears were examined annually for 2 years to assess changes in status and symptoms This is an ongoing study, is this is just the first interpretation of the findings in the sample. Only those who have developed symptoms were included.	Inclusion: individuals unilateral shoulder pain without history of shoulder injury, also discovered to have a rotator cuff tear in symptomatic shoulder, had RCT in asymptomatic contralateral shoulder, and were verified asymptomatic at time of study initiation. Exclusion: history of trauma to shoulder, any past substantial pain in asymptomatic shoulder, continuous use of narcotic pain medication, traumatic episode, inflammatory arthropathy, use of UE for weight bearing	Subjects were monitored for the onset of new pain for 12 months and then divided into groups based on presence of symptoms and further divided at follow up based upon new development of symptoms. Additionally radiographic analysis determined kinematics of the glenohumeral joint at different angles of scaption.	Subjects were closely monitored for onset of spontaneous, new pain. Utilization of real time ultrasonography on both shoulders. SF36, ASES score, ROM, strength at varying ranges using Isobex dynamometer 3 study time points: time of enrollment, annual shoulder examination for asymptomatic OR onset of pain for symptomatic group and last visit was when asymptomatic shoulders returned for second annual shoulder exam OR when symptomatic evaluated for first time after pain development. Statistical analysis was performed between 2nd and 3rd visit within groups and between groups	At enrollment 44 subjects had symptomatic shoulders. Of these, 23% had partial tears and 77% had full-thickness tears. At Visit 2, 4/10 partial tears had progressed to full tears, and 6/34 full thickness tears had increased in size. In other words, 10 (23%) tears had increased in size. 55 subjects had asymptomatic shoulders, of which 36% had partial thickness tears and 64% had full-thickness tears. At visit 2, 0% of partial tears progressed, and 2/35 full thickness tears progressed, indicating a 4% increase in tear size of asymptomatic shoulders. Of the 69 full-thickness tears (both symptomatic and asymptomatic) 27 were dominant shoulder and 47 were non-dominant.	Limitations exist in the blinding of the subjects. Imaging results might contribute to the development of pain or recognition of pathology that could at some point cause pain. This study also had a lot of overlapping outcomes and separation of groups. The details are difficult to follow, but I do not doubt that they had a specific method to dividing groups. A majority of the patients in this study played recreational sports – including golf, swimming, racquet sports and weightlifting. Given this, these results might not portray an accurate representation of the average or sedentary populations. Additionally, presence or rate of development of a rotator cuff tear might be enhanced in this population, skewing the results to appear as though x amount of individuals have a significant increase in the size of their tears within the length of the study. A similar study published in 2022 looking at veterans revealed that 42% of symptomatic partial thickness tears and 29% of full-thickness tears progressed ~2-5 years.

QUALITY	This prospective study is a prognostic study with a Level of Evidence of III. Radiologists were blinded to history and symptoms of subjects, however were not blinded to results of previous sonography, which might have introduced bias to findings. Additionally, this is an early report of an ongoing study. That being said, only subjects who have developed pain at the time of this analysis were included. A longer duration of the study will allow the authors to further characterize the risk of symptom progression over time. See discussion/limitation for specific strengths and limitations within the study.					
Title/Author/Year	Number of Subjects/ Studies	Inclusion/Exclusion	Description of Intervention/Data Synthesis	Outcome Measures/ timeframe	Results	Limitations/Discussion
Shoulder MRI features with clinical correlations in subacromial pain syndrome: a cross-sectional and prognostic study. [3] Kvalvaag E, Anvar M, Karlberg AC, et al. 2017[3]	Prospective observational assessment of patients with subacromial pain syndrome. Included 143 patients 25-70 years old with subacromial pain lasting at least 3 months.	Inclusion: pain on one of two isometric tests, positive Hawkins-Kennedy impingement sign, and normal passive glenohumeral ROM Exclusion: pervious surgery on shoulder, instability, rheumatoid arthritis, full thickness tear of the RC, cervical radiculopathy, infection, patients unable to fill out questionnaires or follow treatment, contraindications to shock wave therapy, previous injection in last 6 weeks,	Patients were randomly assigned to one of two treatment groups shockwave therapy + exercise or sham shockwave therapy + exercise. Patients underwent initial examination/questionnaires and were referred for MRI. Each of a list of set findings on MRI were given one point. (e.g tendinosis in one or more tendons, partial tear, calcification, bursitis, and AC joint arthritis (0-5 points)). Statistical analysis was performed with multiple linear regression analysis with SPADI score at baseline v one year follow-up. Data was adjusted for age, gender, education, work status, and emotional distress. Multiple additional analyses were performed and detailed in the study on imaging.	Everyone underwent 20 supervised sessions within 12 weeks. Average attended was 13 sessions. At baseline, individuals completed demographic, prognostic factors, and SPADI questionnaires. Clinical exam was performed. Patients came for follow-up one year after study termination.	115 patients included (62 female, 53 male) with average age of 47. 104 individuals completed the 1 year follow up. At baseline, SPADI was 52.4 with ~25% AC type 1, ~68% AC type II, ~4% AC type III, and 4% AC type IV. ~25% had calcification in RC and 74% with tendinosis. 35% had partial tear and 56% had bursal effusion. Lastly, 71% had AC joint OA. **8 patients had none of these structural findings on MRI and 3 patients with all 5 findings.** Only significant variable associated with a higher SPADI score at baseline was AROM in abduction. For each 11º increase in AROM, SPADI would decrease by 1.7 points. No significant associations at follow up. MRI was weakly correlated with SPADI score at baseline = no significant correlations between SPADI and individual structural altterations on MRI – except for calcification in the RC. Patients with calcification or high MRI total score, had a lower SPADI score at baseline than those without calcification OR low MRI scores. (less pathology findings)	Previous studies have identified that prevalence of pathology such as rotator cuff or bursa abnormalities are weakly related to symptoms and often found in asymptomatic individuals. The purpose of this study was to identify whether changes in clinical presentation (symptoms) before and after treatment were associated with structural changes on MRI. This RCT attempts to target a different clinical question than most of the research. The sample was in symptomatic individuals who underwent physical therapy treatment to determine if changes in imaging were noted and how they related to clinical presentation. **The main finding of this study was that a higher amount of pathology present on the MRI (0-5 points) predicted poorer outcomes after one year. Of all of these, tendinosis and bursitis predicted a poorer outcome.**

		SPADI less than 20.			After one year: MRI total score (0-5) had strong correlation to change in SPADI score, with 8.1 point decrease in SPADI score for each structural change on MRI.	
QUALITY	This is a randomized controlled trial considers a variety of factors that enhance its quality. These include random allocation, blinding of radiologists, similar baseline characteristics, and sham treatments. This study is moderate to high quality with low risk of bias. It provides valuable information about ability for imaging and outcomes to change, as well as which findings might be more associated with poor outcomes after a one year follow up. The study does not and would be difficult to control for activities, work, and other personal factors that might contribute to the persistence of the condition. Additionally, the individuals attended on average 13 sessions, but this does not account for which participants might have continued with their prescribed exercise or not. Lastly, the study implements a sham and non-sham intervention as well as multiple other subgroup analysis, however does not report the findings of this information. Perhaps these are included in a separate study, as a previous study was mentioned but not specifically referenced. See discussion/limitation for specific strengths and limitations within the study.					
Title/Author/Year	Number of Subjects/ Studies	Inclusion/Exclusion	Description of Intervention/ Data Synthesis	Outcome Measures/ timeframe	Results	Limitations/Discussion
Role of Magnetic Resonance Imaging in the Evaluation of Rotator Cuff Tears[4] Koganti DV et al 2022[4]	50 patients with rotator cuff lesions. Population/study was performed in hospital setting with people coming for symptomatic shoulders.	Inclusion: patients>15 years of age and clinically suspected of rotator cuff pathology. Exclusion: Post-operative cases with hardware, patients with claustrophobia, cardiac pacemakers, metallic foreign body, bio-stimulators, neurostimulators, or cochlear implants in-situ.	MRI and sometimes radiograph of the shoulder were performed. Statistical analysis was performed by entering data into Excel and evaluation using SPSS was used.	The mean and standard deviation were calculated. Gender of patients were reported in percentages. Specific muscle of rotator cuff was identified and pathology was classified as normal, tendinopathy, partial, or complete tears. Percentages of acromion and AC joint configuration	Mean age was 43 years with minimum of 18 and max of 66 years of age. The 5th and 6th decade were found to have the highest occurrence. More than half of the patients were males and 44% were female. Most frequent complaint was pain alone, seen in 40% of patients. Other complaints included stiffness of joing, pain and stiffness combination, difficulty raising arm, and weakness. **Supraspinatus:** 18% (9) of patients had no pathology of the supraspinatus. 82% had pathology with 38% having tendinopathy, 36% having partial tear, and 8% having complete tears. **Infraspinatus:** 82% had no pathology, 9 patients had pathology including tendinopathy, partial tear,	This study is less relevant to the materials of the capstone. It is performed on a biased population, as the individuals came in to receive imaging. The purpose of the study is to identify MR characteristics of the various structures in order to most accurately identify abnormalities in these tendons. The audience is more-so those who read imaging. The study was also to identify influence of age and sex on distribution of rotator cuff pathology, however it is important to note that the *population was symptomatic and excludes the normative information from populations both asymptomatic and symptomatic.* Sample size was limited, small (50), from only one facility. While this study offers important information on the extent to which MRI can detect pathology of the shoulder, it does not

				s were reported.	and complete tear in decreasing order. **Subscapularis:** 58% (29 individuals) had no pathology. Those who had pathology had the same decreasing order as listed above. Further results on shape of acromion and humeral head were included in this study and can be referenced in the open access reference.	provide helpful information on distribution of a broad sample of the population, nor does it provide the amount of individuals that didn't have ANY pathology of the shoulder on imaging but still had pain. This study will not be referenced in handouts because it is not wholly relevant to the information being provided.
QUALITY	This is an evaluative/diagnostic study with information on pathology found in the shoulder of asymptomatic individuals. The sample size is small, from only one facility. There is no information about who/how many radiologist or qualified individuals reviewed the images and no information on the blinding of the reviewer. With a lack of blinding, bias is introduced, as the reviewer is looking for abnormal pathology on the images. This study presents with moderate risk of bias and findings should be considered with caution. See discussion/limitation for specific strengths and limitations within the study.					
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Age-related prevalence of rotator cuff tears in asymptomatic shoulders[5] Tempelhof S, Rupp S, Seil R 1999[5]	Study serves to determine prevalence of rotator cuff tears in asymptoatic shoulders over 50 in Homberg, Germany. 411 subjects ≥ 50 years of age	Participation was voluntary and sampling was somewhat scattered within the hospital setting based on individuals presenting for other things. Patients were excluded if they showed current or acute shoulder pain during the exam. 13 patients spoke of recent shoulder pain and were excluded.	Individuals went through physical therapy examination with ROM, stability, and motor strength testing. Levels of activity, work, and overhead activities were recorded. Patients were divided into 4 age groups (50-59, 60-69, 70-79, ≥80) They underwent sonographic examination with scanning of the RC in transverse and longitudinal planes. Rotator cuff tear was defined as distinct	High resolution 7.5 MHz Ultrasonography was used in real-time to determine presence and size of RCT. Bateman classification was used to determine scale of complete tear. Partial tears were not included. - Bateman I: small <1 cm - Bateman II: moderate, 1-3 cm - Bateman III: large, 3-5 cm	Of 411 individuals: Full-thickness RCT: 23% individuals increased with age - 13% of 50-59 - 20% of 60-69 - 31% of 70-79 - 51% of ≥80 No significant difference in sex distribution. Primarily dominant arm (55%), however, still a large amount of non-dominant arms affected. 50-59: primarily Batemen I and II with no III and IV 60-69: primarily Bateman II and I with 1- III and 1- IV. 70-79: primarily Batemen II, with I and III being similar and 1 with a IV.	This is an older article, published in 1999. The article describes 96 patients as having full-thickness rotator cuff tears (23%) and does not include those with partial RCT. This could limit the extent to which a true representation of individuals with even partial RCT could be analyzed. The data reveals the significant leap in Batemen II classifications at age 60, whereas 50-59 had primarily class I RCT. There were similar characteristics at baseline with no statistically significant difference in sex distribution of tears between groups. There was a highly significant increase of RCT with advancing age. Several other limitations exist. Ultrasonography is not a current gold standard for determining presence of RCT. Sampling is somewhat biased and was performed with existing patients at

			loss of convexity in a longitudinal and transverse plane. Partial thickness tears were not included within this study due to unreliability of echogenicity signs using ultrasonography.	- Bateman IV: massive >5	≥ 80: primarily Batemen II, with I and III being similar and 2 with a IV.	hospitals and outpatient clinics (for other conditions), which might limit the extent to which this study reveals a true representation of the complete population. This study only serves to look at those over 50. Similar study findings should be considered for those below 50, as these are often patients concerned with their shoulder pathology and might need guidance and education regarding age-normative findings for younger individuals.
QUALITY	As this is an older article, more recent literature should be considered for updated information. Additionally, this was performed in one location with ultrasonography. While this is an appropriate tool to use for evaluation of rotator cuff tear, current literature utilize MR imaging for more accurate and holistic evaluation of shoulder pathology. Lastly, the graph-based information in this study seem slightly off. They do not correspond with results shown. Overall, this study should be viewed with caution and only serves to provide basic information about the fact that RCT's can exist in the asymptomatic population. See discussion/limitation for specific strengths and limitations within the study.					

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