PHD THESIS SUMMARY

CLINICAL IMAGING ASPECTS IN PERIARTICULAR CONDITIONS OF THE ATRAUMATIC PAINFUL SHOULDER

PhD student **SĂNDICA COLILIE (ALBINĂ)**

Scientific coordinator **Prof. Univ. Dr. MARIA ŞUŢA, PhD**

"OVIDIUS" UNIVERSITY CONSTANŢA

DOCTORAL SCHOOL OF THE MEDICINE FACULTY

CHAIR OF MEDICAL DISCIPLINES

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The PhD thesis includes:

- ✓ A general part consisting of 3 chapters
- ✓ A personal part consisting of 5 chapters
- ✓ 70 tables
- ✓ 33 figures
- ✓ 173 bibliographic references
- ✓ Two articles on the same subjects as the hereby thesis, published in extenso, as lead author, in B+ magazine, indexed in international databases.

KEY WORDS*: painful shoulder, scapulohumeral periarthritis, tendonitis, tendinopathy, rotator cuff, impingement syndrome, somatization.*

Note: In the summary, we included several tables and figures that comply to the numbering from the thesis. We enclose the table of contents from the PhD thesis.

PHD THESIS TABLE OF CONTENTS

INTRODUCTION

The subject choice is based on several factors regarding the epidemiology, etiology, evolution, diagnosis and treatment of periarticular conditions of the atraumatic painful shoulder.

The atraumatic painful shoulder is a frequent condition among general population, being one of the most common degenerative musculoskeletal disorders described by specialty literature. Some forms of shoulder conditions are refractory to conservative treatment, being able to help determine the onset of adhesive capsulitis with temporary infirmity. The clinical tests described by the medical literature as being specific aren't sufficient in order to precisely establish the diagnosis and the therapeutic plan in case of atraumatic painful shoulder syndrome. For a patient with no record of inflammatory disease that is experiencing atraumatic shoulder pain, the doctor has to chose the most useful, cost-efficient and available medical imaging method, based on the radiology department's experience, especially when he or she asks for an MRI or a musculoskeletal ultrasound, in order to evaluate such a complex region as the shoulder.

The aim of the study is to identify the contribution of the clinical examination and other medical imaging methods in establishing the diagnosis, the therapeutic plan, the evolution, and the prognosis of the atraumatic painful shoulder with a periarticular cause.

PERSONAL STUDY

Research objectives

Main objective

- ✓ Determining the role of clinical examination in diagnosing the atraumatic painful shoulder by establishing the correspondence between the clinical picture and the imaging modifications evidenced through MRI exams.

Secondary objectives

- ✓ Identifying the risk factors for shoulder pain/other type of periarticular injury onset.
- ✓ Identifying the risk factors for shoulder pain persistence.
- ✓ Establishing the role of musculoskeletal ultrasound in determining the injuries caused by periarticular conditions of the atraumatic painful shoulder and drafting a therapeutic plan.

MATERIAL AND METHOD

Patients selection. The prospective observational study took place from October 2012 until April 2013. The patients were chosen from several hospitals (Eforie Nord Clinical Rehabilitation Hospital, Rheumatology Department of the Constanta Emergency Clinical County Hospital and Techirghiol Sanitarium) and 3 centers for medical imaging

investigations from Constanta and one from Techirghiol. The patients' selection was made based on several specific criteria:

Inclusion criteria:

- local shoulder pain that has been persistent for at least two weeks;
- age 18 or more;
- the patient's consent.

Exclusion criteria:

- known chronic inflammatory diseases;
- biological inflammatory syndrome in the moment of enrollment
- recent local major shoulder trauma;
- known neoplastic diseases;
- the patient's refusal.

Study procedure. The thesis is based on the study of 51 patients who signed an informed consent form through which they agreed to participate in this study (Annex 1). In order to obtain objective data, the period of evaluation during enrollment was of at most 7 days for each patient.

When enrolling, the eligible patients were evaluated through:

- ✓ **A questionnaire with the patient's information** and the shoulder pain characteristics (Annex 2).
- ✓ **A questionnaire for establishing the SPADI index** (*Shoulder Pain &Disability Index*) = score through which the pain and functional disability of the shoulder is evaluated by means of 18 questions (Annex 3).
- ✓ ***Woodworth-Mathew*** **questionnaire for establishing the somatization tendency** (Annex 4). The results were interpreted by a

psychologist who established who were the patients with a tendency to somatize their shoulder pain.

- ✓ **Shoulder ultrasound.** The ultrasonography was performed by a rheumatologist with experience in musculoskeletal ultrasound, using a Esaote MyLab 25 Gold machine with linear probe 10-18 MHz. The results were synthesized in a form filled in for each patient (Annex 5).
- ✓ **Shoulder Nuclear Magnetic Resonance (MRI).** Patients' examination through MRI was performed in 4 medical imaging centers using high performance equipment. In the case of all 51 patients, the RMN images were examined by a radiologist with experience in shoulder evaluation. The results were synthesized in a form filled in for each patient (Annex 6).
- ✓ **Laboratory tests** (ESR, CRP, RF, uric acid, glycaemia, and cholesterol). After interpreting the results, were excluded from the study the patients with biological inflammatory syndrome.
- ✓ **General clinical examination and shoulder examination.** The shoulder examination was performed through a passive review and 9 clinical tests (supraspinatus examination, infraspinatus examination, subscapularis examination, Speed's test, Yergason's test, Neer sign, Hawkins' test, abduction against resistance test, "painful arc" test). We chose the tests that the specialty literature describes as specific in identifying periarticular shoulder lesions. The results were synthesized in a form filled in for each patient (Annex 7).

In order to minimize the risk of clinical error, we established an examination protocol for each test, taking into account the fact that, for highlighting a certain periarticular shoulder lesion, the patient's position, the joints' mobility and the examiner's grip are very important.

Based on the established protocols, we took a series of photographs during the clinical examinations in order to better explain the process. Below, we explain, using a demonstrative photograph, the protocol of one of the 9 clinical tests described and used in the thesis.

❖ **Test for subacromial impingement syndrome**

Neer Sign. Patient is in orthostatism. With one hand, we immobilize the scapula (in order to prevent the acromion from lifting during movement), while with the other hand we perform passive anteflexion movement of the arm, which is internally rotated (with the thumb facing the floor) in order to increase the chances of impingement. The scapula lifting immobilization is maintained throughout the anteflexion movement of the arm (Figure 5-6).

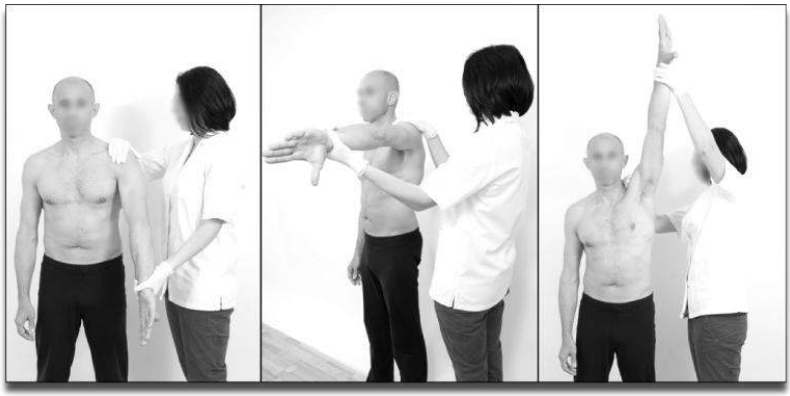

Figure 5-6- Neer Sign (*personal archive*)

The test is positive if the shoulder pain increases together with the anteflexion movement amplitude**,** especially between 90°-140°.

Statistical analysis. The experimental data were processed using the statistical processing program *IBM SPSS Statistics 20*. The procedures used: *Descriptive statistics* (for characterizing the discrete and continuous variables defined at the database level), *Graphics, Parametric statistical tests* (t-test for comparing the means of two dependent/independent samples, One-Way Test ANOVA), *Nonparametric statistical tests* (χ^2 test of association, of the connection between two categorical variables, with the determination in certain situations of the risk/odds ratio OR and relative risk Rr), *Correlation Analysis* (performed for variables measured at interval/ratio level, as well as for variables measured at ordinal and nominal level), *ROC Curves Analysis* (with the determination of sensitivity S_e, specificity S_p, of predictive values - positive VP_+ and negative VP_-, likelihood-ratio LR and of the cut-off value that separates the studied groups for achieving maximum test sensitivity and specificity), *Agreement tests between two variables* (with the estimation of the Kappa coefficient), as well as the *Logistic Regression Analysis* (used to determine the relation between a number of categorical/continuous independent variables and one nominal/binary dichotomous dependent variable which values are codified 0/1).[1-6]

The results considered significant from a statistical point of view were the results for which we obtained a value of statistical $p < 0.05$ (with two tails).

RESULTS

General presentation of the group of patients

The general data conveyed by the forms that we filled in (Annex 2) for all the 51 patients were organized according to patients' characteristics and particularities of painful shoulder syndrome. The patients' characteristics taken into account were gender, age, family conditions (marital status, children into care), educational level, professional status, the practice of a sport that puts a strain on the shoulder (professional or amateur athlete), smoking, associated diseases (diabetes mellitus, dyslipidemia in statin treatment, depression, somatization tendency).

The patients were aged between 29 and 76 years (average age 59 ± 9.9), women prevailing (71%). A great number of patients declared that the last educational establishement they had graduate from was high school. Half of the patients were unemployed when enrolled. Only a quarter of the enrolled patients declared that they were smokers. The psychological examination showed that 18% of the patients had a somatization tendency. The results showed that the painful shoulder is more frequent on the dominant side of the body. Only 14% of the patients declared they were having a child into care. The painful shoulder's particularities taken into account were the onset type, the symptoms' duration, the pain characteristics, the SPADI index SPADI ("*Shoulder Pain and Disability Index"*), the lesions identified through MRI, the number of consultations and the type of treatment prescribed for the shoulder pain before enrolling into the study (Table 6-2).

Table 6-2 - Particularities of the painful shoulder syndrome

Shoulder condition characteristics		Number from the whole group of 51 patients	% from the whole group
Sudden onset		12	23 %
Onset after physical effort		8	16 %
Pain type:	*Nocturnal*	47	92 %
	More intense at night	37	73 %
	Increased by cold	30	59 %
	Permanent	14	27 %
	Burning pain	6	12 %
SPADI	*0-25 %*	4	8 %
	26-50 %	15	29 %
	51-75 %	23	45 %
	76-100 %	9	18 %
Pain persistence	*Less than 6 months*	30	59 %
	More than 6 months	21	41 %
MRI lesion type:	*Supraspinatus tendinopathy*	42	82 %
	Subacromial impingement	41	80 %
	Subacromial bursitis	37	72 %
	Bicipital tendinopathy	28	55 %
	Subscapularis tendinopathy	16	31 %
	Infraspinatus tendinopathy	6	12 %
	Teres minor tendinopathy	1	2 %
More than 3 consultations for pain		33	65 %
Undergone treatment	*NSAID*	42	82 %
	Corticotherapy	14	28 %
	Local injection	11	22 %
	Physical therapy	30	59 %

✓ The usefulness of clinical examination in scapulohumeral periarthritis diagnosis

The subacromial impingement syndrome is most frequently associated with the following clinical manifestations of the painful shoulder: insidious symptoms onset, no cutaneous modifications, mostly nocturnal pain which intensifies due to the ipsilateral decubitus, cold, and arm movement. The correlations between the presence of the impingement on MRI and the clinical manifestations of the painful shoulder don't have values that are statistically significant. The patients suffering from impingement syndrome have an average value of the global SPADI score of 60.6%, and those who don't suffer from impingement syndrome have an average value of 45.5% ($p=0.03$). The association between the presence of the subacromial impingement syndrome on MRI and the treatment with nonsteroidal anti-inflammatory drugs undergone before the enrollment is statistically significant ($p<0.05$). Most frequently, the impingement syndrome is associated with supraspinatus tendinopathy and subacromial bursitis, followed by bicipital tendinopathy. Also, the SIS (shoulder impingement syndrome) isn't associated with the teres minor muscle tendinopathy ($p<0.05$). Yergason's Test was the most specific clinical test and its positive likelihood ratio (LR+) for impingement syndrome was the highest ($p=0.03$). The test with the lowest sensitivity was the one that caused pain in the shoulder when abducting the arm against resistance ($p=0.03$). Hawkins' Test didn't show increased specificity values in the case of our patients diagnosed with SIS based on an MRI.

Supraspinatus tendinopathy was diagnosed through and MRI in the case of 42 patients from the group. Most frequently, it is associated with the following clinical manifestations of the painful shoulder: insidious symptoms onset, burning pain, no cutaneous modifications, mostly nocturnal pain which intensifies due to the ipsilateral decubitus, cold, and arm movement. The association between the clinical manifestations and the supraspinatus tendinopathy on MRI wasn't statistically significant for the studied group. A great number (89%) of the patients from the whole group had already undergone a shoulder pain treatment before enrolling into the study. MRI showed in the case of 83% of these patients supraspinatus tendinopathy (p=0.05). A lot of the patients with supraspinatus tendinopathy had undergone one or more courses of treatment with nonsteroidal anti-inflammatory drugs (88%) (p=0.04). All the patients with partial supraspinatus tendon tear have received one or more treatment courses with NSAID (p=0.013). The test of internal rotation against resistance was the most specific clinical test and had a positive likelihood ratio (LR+). The test with the highest sensitivity was the one that caused pain in the shoulder when abducting the arm against resistance. Supraspinatus test (*„Empty can test"*) didn't have high resistance and specificity values for the presence of supraspinatus tendinopathy on MRI for the studied group (p=NS).

Subacromial bursitis was identified through medical imaging in the case of 37 patients from the group. For 79% of the patients suffering from bursitis, the shoulder pain onset was insidious. In the case of most of the patients suffering from subacromial bursitis, the pain is also experienced at night (98%) and this correlation is statistically significant

(p=0.05). Most frequently, subacromial bursitis is associated with impingement syndrome (95%) or supraspinatus tendinopathy (92%) (p<0.05). The clinical tests with the highest values for specificity and the highest positive likelihood ratio (LR+) for subacromial bursitis were the*"Empty can"* Test (p=0.041) and Speed's Test (p=0.070). The test with the highest sensitivity was the test of abduction against resistance (p=NS).

Bicipital tendinopathy was present on MRI examination in the case of 54% of the patients with painful shoulder. The analysis data showed that there's no statistically significant correlation between the clinical data of the patient with shoulder pain and the presence of bicipital tendinopathy on MRI. The lesion that was the most frequently (93%) associated with bicipital tendinopathy was the subacromial impingement syndrome (p=0.016). Yergason's Test was the most specific clinical test and its positive likelihood ratio (LR+) for bicipital tendinopathy was the highest. The test with the highest sensitivity was the one that caused pain in the shoulder when abducting the arm against resistance. The test with the lowest specificity value was the one that caused pain at over 120° on the painful arc. Speed's Test had relatively low values of sensitivity and specificity. We didn't identify statistically significant correlations between the presence of bicipital tendinopathy on MRI and the clinical tests performed.

Subscapularis tendinopathy was identified in the case of 16 patients from the group. We didn't identifiy statistically significant correlations between the presence of the subscapularis tendinopathy and the clinical characteristics, the type of treatment undergone before enrollment into the study, and the other associated lesions (p>0.05).

Yergason's Test was the most specific clinical test and its positive likelihood ratio (LR+) for subscapularis tendinopathy was the highest. The test with the highest sensitivity was the one that caused pain in the shoulder when abducting the arm against resistance. The test for pain caused by internal rotation against resistance didn't show high sensitivity and specificity values, having a relatively low diagnostic value in patients with subscapularis tendinopathy. We didn't find statistically significant correlations between the presence, on MRI, of subscapularis tendinopathy and the 9 clinical tests used for the study.

Infraspinatus tendinopathy was present only in 6 patients from the group. The statistical analysis of the data didn't underline significant correlations between the presence on MRI of a supraspinatus tendon lesion and the clinical manifestations of the painful shoulder, the type of conservative treatment undergone before enrolling into the study, the association of periarticular lesions. The results of research on the group showed that the test with internal rotation against resistance has the highest specificity and positive likelihood ratio (LR+) for the patients with infraspinatus tendinopathy diagnosed through MRI ($p=0.01$).

From the studied group, only one patient was suffering from **teres minor tendinopathy**, diagnosed through MRI. The patient also suffered from supraspinatus and infraspinatus tendinopathy. In the case of the patient suffering from a teres minor tendon condition, we didn't find statistically significant correlations between the pain characteristics and the tendinopathy presence ($p>0.05$). As for the treatment undergone before enrollment, the patient suffering from teres minor tendinopathy received a recovery treatment and was administered drugs (nonsteroidal

anti-inflammatory drugs, corticotherapy and local injections), but no statistically significant correlations regarding the therapy type were found ($p>0.05$). Because no patient from the group suffered from isolated lesion of the teres minor tendon, we couldn't calculate the value of the clinical tests.

✓ Risk factors for shoulder pain onset

Characteristics of the patients experiencing shoulder pain

Shoulder pain is more frequent in women over 50 years old (72%), half of them falling in the category between 50-60 years. 67% of the men are over 50 years old and 60% fall in the category between 50-60 years. The Chi-square test data showed that there's no statistically significant correlation between the patient's gender and his or her age ($p>0.05$).

Family conditions. From this category, we chose marital status and having a child under 2 years old into care. Most of the patients are married (83%) and 67% of them are women. We didn't identify statistically significant correlations between the family conditions and the gender of the patients ($p > 0.05$).

Educational level. In order to establish the patients' educational level, we chose 3 study categories, according to the last educational establishment attended: middle school, high school and university. The data showed there is a statistically significant correlation between the educational level and the patient's gender ($p=0.023$).

Professional status. Regarding the professional status, 22 of the patients have a job, one is unemployed and 28 are retired. There are no statistically significant correlations between the patient's gender and his or her occupation ($p>0.05$).

Physical strain. Physical strain was considered to be the intense physical activity, as well as the repeated movement of the shoulder at work, when practicing a sport (as a professional or amateur athlete) or when having a habit (smoking). Only 3 of the patients declared practicing a sport (amateur players) and all of them are men (0.022). We found that there's a statistically significant correlation between smoking and shoulder pain ($p=0.047$).

Associated conditions. The conditions taken into account were: diabetes mellitus, dyslipidemia, depression, somatization tendency. The association between the chronic treatment with statin and shoulder pain had a value close to the statistical significance ($p=0.06$). The value of the correlation between shoulder pain in patients suffering from depression was close to the statistical significance ($p=0.07$). The somatization tendency was present in 9 patients from the group. All patients with somatization tendency are women. The results show that shoulder pain correlates with the somatization tendency ($p=0.03$).

Characteristics of the painful shoulder syndrome

Affected shoulder particularities. We searched if there was a connection between the pain onset and the particularity of its

localization - if it appeared on the dominant side of the body, if it is the first flare-up on the affected side, if it is associated with pain in the other shoulder too (currently but also in the patient's medical history). Our study's data didn't show statistically significant correlations between the shoulder pain onset and the particularity of its localization ($p>0.05$).

Pain onset. We checked the way in which the pain begins (suddenly or insidiously), as well as the time of the year when it is the most frequent. We identified a statistically significant correlation between the shoulder pain presence and its type of onset ($p=0.01$). We didn't identify a statistically significant connection between the pain presence and the month when it began. ($p>0.05$).

Shoulder pain particularities. We evaluated the shoulder pain particularities. The symptoms were separated, according to their length, in two categories (under 6 months and over 6 months). We didn't identify a statistically significant correlation between the shoulder pain characteristics and the symptoms' persistence.

✓ Risk factors for scapulohumeral periarthritis onset

We studied if the patient's general information can be risk factors for the emergence of certain periarticular shoulder lesions. The characteristics we studied were related to personal information (age, gender, educational level, marital status, occupation) and to associated conditions (diabetes mellitus, dyslipidemia and psychological disorders that could lead to the somatization tendency).

We also studied the conditions that involved repeated movements of the shoulder before the pain onset (strain caused by domestic chores or by professional activites, caring for a baby, practicing a sport as a professional or as an amateur athlete, the habit of smoking, pain in the dominant shoulder).

A part of the results we obtained are shown in table 6-60.

Table 6-60 - The results of the correlations between the general information of the patients and the most frequent periarticular shoulder lesions

Patient's general information	Impingement syndrome (p)	Subacromial bursitis (p)	Supraspinatus tendinopathy (p)
Age	**0.000**	**0.003**	**0.012**
Sex	0.116	0.170	0.532
Marital status	0.819	0.168	0.310
Child in care	0.126	0.287	0.095
Educational level	0.109	**0.003**	**0.009**
Dominant shoulder	0.150	0.537	**0.020**
First flare-up	0.501	0.392	0.390
Opposite shoulder previously affected	0.621	0.389	0.532
Smoker	0.075	0.586	**0.008**
Diabetes mellitus	0.638	0.439	0.429
Dyslipidemia	0.499	0.062	0.263
Somatization tendency	0.571	0.473	0.504
Professional athlete	0.090	0.075	0.238
Amateur athlete	0.488	0.627	0.449
Professional physical strain	0.560	0.463	0.359
Professional status	**0.004**	**0.041**	0.068

✓ Risk factors for shoulder pain persistence

In order to establish the factors that can determine the persistence of the scapulohumeral periarthritis symptoms, we studied the influence of the patient's characteristics (demographic data, family data, educational level, professional status, associated conditions, habits), but also the influence of the condition's characteristics (type of lesion, type of onset, type of pain, the undergone treatment before the enrollment). Through statistical analysis, we discovered that there's a significant association between the educational level of the patient and the pain persistence (p=0.021).

The majority of patients who attended only middle school were enrolled into the study after more than 6 months from the pain onset. 97% of the patients with pain that has been persistent for less than 6 months have graduated at least from high school. The association with the following elements is also statistically significant for pain persistence: opposite shoulder previously affected (p=0.019), diabetes mellitus (p=0.045), insidious onset (p=0.048), physical therapy (0.028), local injection (p=0.048).

In order to find out if certain characteristics of the patients or of the condition are risk factors for shoulder pain persistence, we performed the method of logistic regression, using the Nonselective Standard Model (ENTER).

From table 6-62 which contains the results of logistic regression, we notice that the statistically significant predictive factors are: dominant shoulder, diabetes mellitus, physical therapy, local injection, burning pain, and continuous pain. There's a 10.212 times higher risk for

the pain to persist for more than 6 months in the case of patients with a dominant shoulder lesion, and a 16.997 times higher risk for patients who suffer from diabetes mellitus in association with the shoulder condition. As for the treatment undergone before enrolling into the study, we notice that the risk for the pain to persist more than 6 months is 21 time higher in those who underwent physical therapy and for those with local injection.

Table 6-62 - Results of the logistic regression for risk factor for shoulder pain persistence

Patient information	Calculated coefficient * (B)	p	Risk ratio **Exp(B)	Confidence interval 95% for Exp(B)	
				minimum	maximum
Age	.074	0.274	1.077	.943	1.231
Sex	-1.232	0.327	.292	.025	3.427
Dominant_shoulder	2.324	**0.047**	10.212	1.040	105.544
Smoker	.094	0.931	1.098	.130	9.282
Diabetes mellitus	2.833	**0.036**	16.997	1.210	238.817
Professional strain	.653	0.606	1.922	.161	22.999
Sudden_onset	-1.982	0.181	.138	.008	2.516
Nocturnal_pain	-1.925	0.325	.146	.003	6.747
Previous_treatment	-4.232	0.085	.015	.000	1.799
Physical therapy	3.032	**0.028**	20.738	1.395	308.242
Cortisone_treatment	1.485	0.206	4.417	.442	44.155
Local_injection	3.065	**0.048**	21.437	1.015	452.859
Burning_pain	4.551	**0.047**	94.697	1.078	10769.400
Continuous_pain	-3.181	**0.025**	.042	.003	.676
Somatization_tendency	-2.363	0.173	.094	.003	2.822

The higher risk in determining the symptoms persistence for more than 6 months is the burning pain (risk for ~ 95 times higher). The risk for the symptoms to persist more than 6 months before seeing a doctor is 23.80 times smaller for patients with continuous shoulder pain.

✓ The role of ultrasound in scapulohumeral periarthritis

Through shoulder ultrasound, we identified, in order of frequency, the following lesions: supraspinatus tendinopathy (71%), impingement syndrome (52%), subacromial bursitis (37%), bicipital tendinopathy (37%), infraspinatus tendinopathy (6%) and teres minor tendinopathy (4%). We analyzed the concordance degree between MRI and ultrasound results for the studied group. The results are shown in table 6-66.

Table 6-66 - Correspondence between MRI and Shoulder ultrasonography

Lesion type		No. patients with lesion on MRI	No. patients "true positive" *	No. patients "true negative" **	Methods concordance ***	Kappa score ****
Supraspinatus	TD	31	10	11	41.2%	-0.115
	TZ	8	2	38	76.5%	0.141
	RPT	18	5	26	52.8%	0.071
	TP	42	30	3	64.7%	0.038
Subscapularis	TD	12	4	34	74.5%	0.225
	TZ	3	0	45	88.2%	-0.063
	RPT	3	0	46	90.1%	-0.049
	TP	16	4	25	56.8%	0.037

Lesion type		No. patients with lesion on MRI	No. patients "true positive" *	No. patients "true negative" **	Methods concordance ***	Kappa score ****
Infraspinatus	TD	6	0	42	82.3%	-0.085
	TP	6	0	42	88.2%	-0.085
Teres minor	TD	1	0	48	94.1%	-0.027
	TP	1	0	48	94.1%	-0.027
Bicipital	TD	28	14	20	66.6%	0.354
	TP	28	16	20	70.5%	0.426
Capsulitis		11	1	38	75.5%	0.056
Bursitis		37	14	9	45.1%	0.015
Impingement		41	23	4	70.73%	0.105

*Number of patients with the same lesion identified through both MRI and ultrasound ("true positives"), **Number of patients with the same lesion that wasn't identified through MRI nor ultrasound ("true negatives"), ***Concordance = ("true positives"+"true negatives") / Total number of patients, ****Compatibility according to the Kappa coefficient: K<0 (without compatibility), k=0.01-0.20 (poor compatibility), k=0.21-0.40 (weak compatibility), k=0.40-0.60 (moderate compatibility), k=0.61-0.80 (strong compatibility), k=0.81-0.99 (almost perfect compatibility)

The strongest compatibility between the MRI and shoulder ultrasound was in the case of bicipital tendon lesions (p=0.001). Weak compatibility was identified for supraspinatus and subscapularis muscles tendons lesions, in case of impingement syndrome, as well as subacromial bursitis and adhesive capsulitis. We didn't identified compatibility when evaluating the infraspinatus and teres minor muscle, even if the concordance between the imaging methods used has high values.

We also researched the role of musculoskeletal ultrasound in identifying shoulder periarticular lesions. We studied the most frequent conditions that lead to shoulder pain. We couldn't calculate the diagnostic parameters of the musculoskeletal ultrasound for the tendons of the infraspinatus and teres minor muscles because, after calculating the compatibility between the ultrasound and MRI, we didn't identify a patient that had the same type of lesion on the both medical imaging methods.

As for the parameters for identifying the lesions of the supraspinatus tendon, the musculoskeletal ultrasound shows increased sensitivity for unspecified modifications at tendon level ("tendinopathy") and low values of the method's sensitivity in identifying a certain type of lesion. The most important specificity was in the case of tendinosis. In order to evaluate the lesions of the supraspinatus muscle tendon, the ultrasound can rather identify tendinosis lesions (accuracy of 78.43%) than tendinitis ones, but it can establish the presence of a structural condition of the tendon, with a positive predictive value of the ultrasound for the tendinopathy of 83.33%.

In case of subscapularis tendon, the ultrasound shows more accurately the tendinitis lesions, and less accurately the degenerative ones like tendinosis or partial tear, and it can be used to diagnose the inflammatory lesions of this tendon.

The diagnostic value of the ultrasound is comparable in the case of impingement syndrome lesions, subacromial bursitis and adhesive capsulitis lesions. From all the studied periarticular conditions, the diagnostic parameters of the ultrasound had the highest values when identifying the lesions of the long tendon of the biceps brahii.

CONCLUSIONS

Conclusions regarding the general characteristics of the patient experiencing shoulder pain

- The atraumatic painful shoulder with periarticular cause is more frequent in women with an average age of 57 ± 9.9 years.
- The patients with lower educational level rarely see a specialist for shoulder pain.
- In general, atraumatic scapulohumeral periarthritis appears in the dominant shoulder.
- Frequently, the onset is insidious, without being preceded by intense physical effort.
- The pain increases at night, when moving the arm and it isn't influenced by extreme temperature.
- The shoulder pain can last more than 6 months.
- The scapulohumeral periarthritis affects more than 50% of the shoulder's functionality.
- The patients suffering from scapulohumeral periarthritis go to more than 3 doctor appointments for the same painful flare-up.
- For atraumatic shoulder pain, the drugs that doctors prescribe the most frequently are NSAIDs followed by physical therapy. Patients rarely undergo corticosteroids treatments or local injections.

The importance of clinical examination in scapulohumeral periarthritis diagnosis

Subacromial impingement syndrome (SIS)

- Impingement syndrome doesn't have specific clinical manifestations.
- SIS affects more than 75% of the global functionality of the shoulder. The patients with a SPADI index of less than 50% don't suffer from impingement syndrome.
- The NSAID treatment doesn't alleviate or can even worsen the pain caused by SIS.
- Most frequently, the impingement syndrome is associated with supraspinatus tendinopathy and subacromial bursitis, followed by bicipital tendinopathy. Also, it isn't associated with the teres minor muscle tendinopathy.
- The Neer and Hawkins tests, performed individually, don't show increased specificity in the case of SIS.
- Positive Yergason test correlates with the presence of impingement syndrome.
- Pain when abducting the arm against resistance can suggest subacromial impingement.
- The association of several positive tests can increase the clinical diagnosis accuracy in the case of impingement syndrome.

Supraspinatus tendinopathy:

- Supraspinatus tendon lesions don't have specific clinical manifestations.
- Intense shoulder pain that resembles burning pain can indicate pathology of the supraspinatus tendon.
- In the case of patients suffering from supraspinatus tendinosis, pain intensifies at night due to ipsilateral decubitus and cold exposure.
- SPADI index isn't useful in evaluating patients suffering only from supraspinatus tendinopathy.
- Clinical tests described by the specialty literature for the supraspinatus tendinopathy ("Empty can" test, arm abduction against resistance), individually performed, don't have high values of the clinical prediction parameters.
- Pain that appears at more than 60° of passive external rotation suggests a lesion of the supraspinatus tendon.
- The NSAID treatment doesn't improve the symptoms of supraspinatus tendon lesions, especially in the case of partial tear.

Subacromial bursitis:

- Subacromial bursitis doesn't have specific clinical manifestations.
- Patients suffering from subacromial bursitis experience also nocturnal pain.
- SPADI index isn't useful in evaluating patients with shoulder pain and subacromial bursitis.

- Clinical "Empty can" and Speed's tests have increased clinical accuracy in case of patients suffering from subacromial bursitis.

Bicipital tendinopathy:

- The lesions of the tendon of the biceps' long head don't have specific clinical manifestations.
- SPADI index isn't useful in evaluating patients suffering from bicipital tendinopathy.
- The Yergason test is the most useful in setting the clinical diagnosis of bicipital tendinopathy.
- Because the bicipital tendon participates in stabilizing the arm when stretched, the pain during the tests that consist of stretching the arm (abduction against resistance, "Empty can" test, Yergason test) can also be cause by bicipital tendinitis.
- The NSAID treatment doesn't improve the symptoms of bicipital tendon lesions.
- The conditions of subscapularis, infraspinatus and teres minor muscles rarely appear as isolated lesions in patients experiencing shoulder pain with no local trauma. Their presence as associated lesions don't cause specific clinical manifestations.

Conclusions regarding risk factors for shoulder pain onset

- The risk factors for shoulder pain onset in case of atraumatic lesions of the rotator cuff are non-specific.

- The shoulder pain onset isn't influenced by age, gender, professional status, physical strain, season, dominant shoulder.
- Depression and somatization tendency are risk factors for pain onset in patients that suffer from atraumatic periarticular lesions of the shoulder.

Conclusions regarding risk factors for the onset of certain periarticular shoulder lesions

- The type of periarticular shoulder lesion isn't influenced by: gender, physical strain, having a child into care, associated conditions (diabetes mellitus, dyslipidemia, depression, somatization tendency).
- Supraspinatus tendinopathy is more frequently diagnosed in patients with certain characteristics: over 50 years old, high educational level, condition affecting the dominant shoulder, smokers.
- The impingement syndrome is more frequent in the case of retired patients that are over 60 years old.
- Bursitis is more frequent in the case of patients that are over 50 years old, high school graduates, that aren't working.
- In the case of patients that are over 50 years old, the atraumatic painful shoulder is caused by supraspinatus tendinopathy together with impingement syndrome and subacromial bursitis.

Conclusions regarding risk factors for the persistence of shoulder pain

- The factors that determine shoulder pain persistence are non-specific.
- Shoulder pain persistence is not determined by age, gender, having a child into care, dominant shoulder, smoking, profession, lesion type, the month of onset.
- The majority of patients who attended only middle school went to see a specialist after over 6 months from the pain onset.
- The risk for the pain to persist more than 6 months is 17 times higher in the case of patients who also suffer from diabetes mellitus.
- Pain can become chronic if the patients previously suffered from pain in the opposite shoulder.
- The symptoms can last for over 6 months if the onset was insidious.
- The physical therapy and local injection don't alleviate the symptoms, so the risk for the pain to persist for over 6 months is approximately 21 time higher in the case of patients who undergo physical therapy but also in the case of those who undergo local injections.
- The higher risk of pain persistence for over 6 months is in the case of burning pain (risk approximately 95 time higher).
- The risk for the symptoms to persist more than 6 months before seeing a doctor is 24 times smaller for patients with continuous shoulder pain.
- The somatization tendency can determine symptoms persistence in the case of patients suffering from atraumatic shoulder pain.

The role of ultrasonography in scapulohumeral periarthritis diagnosis

- From the rotator cuff, the supraspinatus muscle tendon is the most frequently affected, fact shown both on MRI and ultrasound, in the case of patients suffering from atraumatic painful shoulder.
- In order to evaluate the lesions of the supraspinatus muscle tendon, the ultrasound can rather identify tendinosis lesions than tendinitis ones, but it can establish the presence of a structural condition of the tendon, with an increased positive predictive value.
- Subacromial bursitis is rarely an isolated cause of shoulder pain, being associated most of the times with conditions of the supraspinatus tendon, shown both on MRI and ultrasound.
- The diagnostic value of the ultrasound is comparable to the MRI exam in the case of impingement syndrome lesions, subacromial bursitis and adhesive capsulitis lesions.
- From all the studied periarticular conditions, the diagnostic parameters of the ultrasound had the highest values when identifying the lesions of the long tendon of the biceps brahii.

GENERAL CONCLUSIONS

- There are also asymptomatic periarticular shoulder lesions.
- The most frequent causes of atraumatic periarticular painful shoulder are: supraspinatus tendinopathy associated with subacromial impingement shoulder, subacromial bursitis and bicipital tendinopathy.
- It is difficult to establish the interdependence between the presence of the impingement syndrome and supraspinatus tendinopathy.
- The rotator cuff stabilizes the glenohumeral joint in every movement direction of the arm during clinical testing and when shoulder pain can have as cause any one of the periarticular lesions.
- A thorough clinical test is useful only in terms of orientation because it can help determine if a periarticular shoulder condition exists. There's a need for additional imaging investigations in order to establish the differential diagnosis rather than to set out a therapeutic plan. For choosing the treatment (conservative or surgical), it is sufficient to establish the clinical presentation of scapulohumeral periarthritis.
- The MRI examination remains the "gold standard" for diagnosing and staging the periarticular shoulder lesions.
- Taking into account that through a shoulder ultrasound one can see the most frequent static (subacromial bursitis, supraspinatus tendinopathy, subscapularis tendinitis, bicipital tendinopathy)

and dynamic (impingement syndrome, bicipital tendon subluxation and dislocation) periarticular lesions, this could be the main imaging method used for diagnosing the atraumatic painful shoulder with periarticular cause.

- Ultrasound can be used as unique imaging method in diagnosing the lesions of the long head of the biceps' tendon.
- The patients with chronic shoulder pain and somatization tendency's have the following profile: female, nocturnal pain, diabetes mellitus association, previously undergone steroids injections, dominant shoulder affected, low educational level and important global shoulder disability.
- Careful anamnesis, thorough clinical examination followed by a shoulder ultrasound can be sufficient to establish a diagnosis and a therapeutic plan for a patient suffering from painful shoulder with periarticular cause.

THESIS ORIGINALITY AND INNOVATIVE CONTRIBUTIONS

The originality of this thesis resides in the fact that even though patients came from different hospitals and medical imaging centers, the evaluation was extremely complex: thorough clinical examination, lab tests, psychological evaluation, imaging examination of the shoulder through both MRI and ultrasound. In order to limit MRI diagnosis errors with patients selected from 4 different medical imaging centers, all the results were reevaluated by a radiologist with experience in shoulder MRI. For the dynamic imaging examination of the shoulder, in the case of all 51 patients we chose to collaborate with an experienced rheumatologist who used an ultrasound machine with a high-performance probe. Wishing to establish as objectively as possible the concordance between the clinical and paraclinical manifestations, we chose for the enrollment period to not last more than 7 days, which created a difficulty in enrolling more patients. The statistical analysis of the data was done in collaboration with a statistician with experience in medical studies. A new element that the study underlines is the research of the interdependence between somatization tendency and shoulder pain, a subject that is insufficiently approached by medical literature. In order to underline a certain shoulder pain somatization tendency, the psychological examination in the case of all the patients was done by the same psychologist in collaboration with a psychiatrist.

The utility of this study is represented by the fact that we supply practically applicable information in order to improve the process of establishing the diagnosis and the therapy of the patient suffering from painful shoulder.

Even if a part of our results aren't statistically significant, the enrollment criteria and the evaluation ways not allowing the selection of a great number of patients, they can represent the basis for future research.