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Prevalence of Reumatological Manifestations Among Diabetes Mellitus

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ABSTRACT

Background: The Diabetes mellitus (DM) is a key secondary cause of many reumatological disorders especially osteoarthritis, shoulder hand syndrome, frozen shoulder, and trigger finger. Patients with diabetes commonly have Rheumatic complaints. They control good glycemic by doing exercises, following a diet, and taking medication which can improve or prevent the development of rheumatic conditions.

Aim of study: The current study aims at finding the frequency of rheumatic situations for diabetes mellitus.

Patients and methods: Hundreds of patients randomly were taken from the diabetic center of endocrinology at AL-Sadder teaching Hospital in Najaf city through the period of July 2010-March to 2011. Each patient subjected to complete clinical history, examinations, x-ray, height, weight and HbA1c measurement.

Results: prevalence of rheumatological manifestations in diabetic patients was osteoarthritis (40%),diabetic hand syndrome (16.8%),frozen shoulder (12%), shoulder hand syndrome (12%),trigger finger(7.2%),diffuse idiopathic skeletal hyperostosis(6.4%),Depatterns contracture (4.8%) and Charcot s joint (0.8%).There was a significant relationship between osteoarthritis, the syndrome of diabetic hand, diffusing idiopathic skeletal hyperostosis at p value <0.007,0.019,0.027 respectively, and insignificant with frozen shoulder, Depattern's contracture, trigger finger, Charcot's joint, shoulder hand syndrome at p >0.426,0.141,0.401,0.503,0.140 respectively among type 2 and type 1 diabetes mellitus .

Conclusion: Rheumatological disorders are a common complication of diabetes mellitus. They are directly interrelated to patient's age, span of diabetes mellitus.

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INTRODUCTION

The long-term results of treatment of diabetes mellitus are disappointing, so that the complications might occur leading to excess mortality and morbidity. The mechanisms of complications in DM are ill defined probably due to non-enzymatic glycosylation in various proteins, such as Hemoglobin, collagen and tubulin found in peripheral nerves.This could lead to an amassing advanced glycosylation ending products which causean injury, and inflammation by stimulating complement element and cytokines[1]. Of the various complications of diabetes mellitus (DM),rheumatological manifestation lead to considerable morbidity. These are: adhesive capsulitis known as (frozen shoulder), (SHS) shoulder hand syndrome, (DHS) diabetic hand syndrome, diffused idiopathic skeletal hyperostosis (DISH), Dipyrrin's contracture (DC) and neuroarthropathy are characteristically associated with DM. Of these, adhesive capsulitis and DISH have such a close relationship with DM that often led to diagnosis of DM in an asymptomatic patient. Other rheumatological diseases, commonly found in the general population, had an increased frequency in the diabetic population[2]. These are osteoarthritis (OA), especially of the hip, knee and spine, and osteoporosis and osteolysis of the forefoot, migratory osteolysis of hip and knee and pseudogout. All of these diseases have an acute clinical course and unfavorable prognosis in the diabetic population[3].

Frozen shoulder

Adhesive capsulitis is one of the common disabling musculoskeletal renowned as "frozen shoulder", or as "shoulder periarthritis", or also known as obliterate bursitis.It is characterizedby

being progressive, severe painful restraint of the move of shoulder, particularly outer rotation as well as abduction[5]. The condensed capsule of joint has been applied thoroughly and stick to the humeral head, leading to inconsiderable reduction at the level of the glenohumeral joint.The specific accurate origins related to adhesive capsulitis could not be identified, though it had been concomitant to various other circumstances, such as shoulder trauma, cerebrovascular accident,myocardial infarction and acute respiratory distress syndrome on ventilation. The history of this disease is known and identified by three key attributes: being painful, adhesive, in addition to resolutionphases[5]. Young age people appear to have adhesive capsulitis with diabetes, and it is slightly painful,[6]though its response to treatment is not fast, but lasts longer.[7]Adhesive capsulitis is interrelated to the span of diabetes and the chronological age[10].

Other diabetic complications including limited motion of joint appear to affect those diabetic patients of frozen shoulder. These complications are more likely in patients of frozen shoulder than diabetic patients other than a frozen shoulder, even if this may be described by age[9].

Cheiroarthopathy

(it is named at the word "cheiros" referring toa hand in Greek). This is characterized by being thick, in addition to tightness, and it has a waxy texture on the dorsal facet of hands. It is accompanied with defects in flexion of the metacarpophalangea land interphalangeal joints (showing increased resistance to passive extension of the joints). The motion of joint which is limited can be presented clinically by incapability of the two palms to go entirely together, with the wrists maximally flexed,forming the prayer sign.Early, development of paraesthesias and a very slight ache might be noticed. The signsof this disease rise slowly, with striking pain, forced by hand movement may be interrupting tissue removal samplings of involved skin.This condition is figured commonly in type 1 diabetics.

Dupuytren's contracture

It is common inthe identical patient.[13]Its treatment includes an optimizing control of glycaemic and modified hand therapy course if the indicator spay warrant to it.Dupuytren'scontracture can be regarded as the palmar or the digital thickening,chaining, or contracture of the hands. In diabetes, it is noticed that the middle finger and ring one are more commonly affected, compared with the little one for those who have notdiabetes.[15]Generally, the contractures can be milder in diabetics than in Dupuytren'scontracture patients who are non-diabetic, and the prevalence rises with age progressing.[17] Treatment comprises of controlling and optimizing glycaemic, physio-therapy, and handy exercises when involved, and surgery only if function is severely affected[6].

Flexor tenosynovitis (trigger finger)

Fibrous tissue is the real cause for flexor tenosynovitis proliferation in the tendon sheath which could lead to limitation of the tendon normal moves.Flexor tenosynovitis is linked with the time span of diabetes, but not age.[21]Injecting symptomatic flexor tendon sheath with corticosteroid injection is often curative[22].

Diffuse idiopathic skeletal hyperostosis

(Forestier's disease). New bone formation is one of the characteristics of Forestier's disease, particularly in the thoracolumbar spine.New bone appears to "flow" from one vertebrato the next, and is more prominent on the right side of the thoracic vertebra.[25] Ossification of ligaments and tendons elsewhere may occur, such as the skull, pelvis, heels, orelbows[26].Prolonged high levels of insulin or insulin like growth factor, which occur in diabetic patients, motivating new bone is a

proposed mechanism of causation.[16]One-third number of patients having heels or elbows hyperostosis may suffer pain. Spine hyperostosis patients may have mild difficulty in arising at morning.[12]

Osteoarthritis diabetes

It is not regarded as a risky cause for osteoarthritis (OA). But obesity is regarded as a risk cause for both settings. Many studies have showed a tight relationship of early OA and diabetes. It is noticed that large and small joints OA were stated as increasing in type 2 diabetes. Nevertheless, OA of the joints of weight-lifting people in the affected category 2 diabetic patients can be ascribed to obesity not to the diabetes itself. It has not been known that diabetes is a risky cause for OA which is independent of obesity.

Charcot's disease

diabetic peripheral neuropathy can be the main cause for Charcot's disease.Progressive, painless joint destruction may be resulted due to the decrease of the normal protecting neural impulses. Therefore, lack of fortification from trauma to the joint.Charcot's joints are normally noticed in patients whose age are more than 50 and had diabetes for several years with existence of neuropathic complications. Weight-bearing joints like foot, ankles, and knees are the most likely affected joints, while the hands and wrists can hardly be affected.[27]Early warmth and erythema resemble to osteomyelitis or septic arthritis, nonexistence of fever, increased white cell count, and increased erythrocyte sedimentation proportions lead to differentiate the latter two cases.

Patients and methods

Hundreds of patients randomly taken from the diabetic patients attending at diabetic center of endocrinology at Al-Sadder teaching Hospital in Najaf city from July 2010 to March 2011.

Detailed history was taken referring to the patients' age, time span of diabetes mellitus(DM),sex,type of diabetes,type of medications and weight.All of the patients experienced routine inquiries such as CBC complete blood counts, UA urine analyses, in addition to fasting and glucose of post-prandial plasma, as well as serum uric acid, urea and creatinine in addition to X-ray of hand,shoulder, as well as spine and many other required joints were carried out. The level of serum uric acid was upto 7.0 mg/dl in adult males and post-menopausal females was estimated as normal.[3].

The estimation of Glycosylated hemoglobin(HbA1c) was carried out in all selected sitautions.HbA1c was measured for all patients by Hemoglobin electrophoresis using Hb- variant device by taken 1ml of blood with EDTA, and according to WHO criteria for controlling of DM ; HbA1c should be ≤ 7 % [3].

Tagging DM into type 1 and 2 was conducted according to WHO criteria[4].

Anthropometric measurements which were taken had been standing highly without shoes in meters and weight[28].

Two tiesor more available between contiguous vertebrae to be selected for the diagnosis of DISH[4].The Diabetic finale phase of renal disease was excluded to patients with renal osteodystrophy[29].

FS Diagnose is carried out clinically by using scratching test which is a clinical test use for the diagnosis of FS. The patient is asked to scratch middle side of opposite scapula in three directions,from above same side, then from above across the neck[8].

The statistical study

It was cross sectional (prevalence study) with p value<0.05 was taken as significant

Results

Our study included hundred patients in which there was (42%) males, (58%) females, (18%)

type 1 and (82%) type 2 diabetes mellitus. The age ranging in between (9 – 82) years. The mean of age (52.32±15.191 years).The mean of duration of study group that complains from DM was (10.14±7.375) years.The mean of HbA1c was (9.1021±2.01)%, while S.uric acid was (3.95±1.517)mg/dl as shown in table 1 and 2 :

Table 1. shows the basic characteristics of the study

	Minimum	Maximum	Mean	Std. Deviation
age/years	9.0	82.0	52.32	15.1909
Duration/years	1.0	30.0	10.14	7.3745
HbA1c%	5.7	14.1	9.1021	2.0088
Serum uric acid mg/dl	1.8	7.00	3.9524	1.51739

Table 2. shows characteristics according to type of DM

	type of DM	Nomber	Mean	Std. Deviation
age/years	TYPE 1 DM	18	33.55	19.716
	TYPE 2 DM	82	56.44	10.249
Duration/years	TYPE 1 DM	18	14.11	9.851
	TYPE 2 DM	82	9.27	6.467
HbA1c%	TYPE 1 DM	18	9.022	1.42232
	TYPE 2 DM	82	9.1169	2.12275
Serum uric acid mg/dl	TYPE 1 DM	18	3.6222	1.920
	TYPE 2 DM	82	4.0248	1.4810

Age p=0.007, HbA1c p=0.853Serum uric acid p=0.310 duration p=0.011

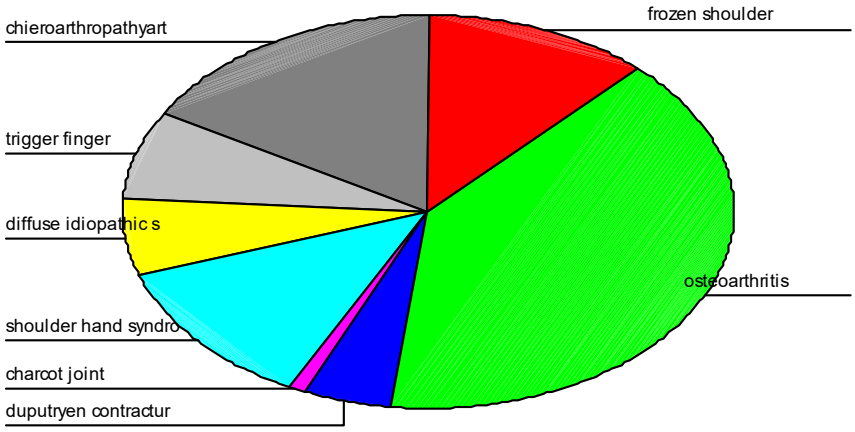

Figure 1. shown the prevalence of joint manifestations.

T1 DM had been cross tabulated with T2 DM with respect to clinical findings suggestive of frozen shoulder to evaluate the prevalence of FS as shown in table (3):

Table 3 show type of DM and frozen shoulder.

			FROZEN SHOULDER		
			POSITIVE	NEGATIVE	Total
ype of DM	TYPE 1 DM	Count	4	14	18
		% within type of DM	22.2%	77.8%	100.0%
	TYPE 2 DM	Count	26	56	82
		% within type of DM	31.7%	68.3%	100.0%
Total		Count	30	70	100
		% within type of DM	30.0%	70.0%	100.0%

P=0.4

Table (4) show the distribution of osteoarthritis among diabetic patients in different joints in which there are 51.6% of patients knee joint is affected then spine 16.1% then other joints.

Table 4. Distribution of osteoarthritis among diabetic patients.

	Frequency	Percent
knee	32	51.6
Hip	5	8.1
Spine	10	16.1
Hand	8	12.9
Mixed	7	11.3
Total	62	100.0

T1 DM had been cross tabulated with T2 DM with respect to clinical findings suggestive of Dupuytren contracture to evaluate the prevalence of DC as shown in table below:

Table 5. show type of DM and Dupuytren contracture.

			DUPUYTREN CONTRACTURES		
			POSITIVE	NEGATIVE	Total
ype of DM	TYPE 1 DM	Count	4	14	18
		% within type of DM	22.2%	77.8%	100.0%
	TYPE 2 DM	Count	8	74	82
		% within type of DM	9.8%	90.2%	100.0%
Total		Count	12	88	100
		% within type of DM	12.0%	88.0%	100.0%

P=0.141

T1 DM had been cross tabulated with T2 DM with respect to clinical findings suggestive of Charcot joint to evaluate the prevalence of CJ as shown in table below:

Table 6. show type of DM and Charcot joint.

			CHARCOT JOINT ON X-RAY		
			+VE	-VE	Total
ype of DM	TYPE 1 DM	Count		18	18
		% within type of DM		100.0%	100.0%
	TYPE 2 DM	Count	2	80	82
		% within type of DM	2.4%	97.6%	100.0%
Total		Count	2	98	100
		% within type of DM	2.0%	98.0%	100.0%

P=0.503

T1 DM had been cross tabulated with T2 DM with respect to clinical findings suggestive of shoulder hand syndrome to evaluate the prevalence of SHS as shown in table below:

Table 7. show type of DM and shoulder hand syndrome.

			SHOULDER HAND SYNDROME		
			positive	negative	Total
ype of DM	TYPE 1 DM	Count	8	10	18
		% within type of DM	44.4%	55.6%	100.0%
	TYPE 2 DM	Count	22	60	82
		% within type of DM	26.8%	73.2%	100.0%
Total		Count	30	70	100
		% within type of DM	30.0%	70.0%	100.0%

P=0.140

T1 DM had been cross tabulated with T2 DM with respect to clinical findings suggestive of diabetic hand syndrome evaluate the prevalence of DHS as shown in table below:

Table 8. show type of DM and diabetic hand syndrome.

			chieroarthropathy (DHS)		
			positive	negative	Total
ype of DM	TYPE 1 DM	Count	10	8	18
		% within type of DM	55.6%	44.4%	100.0%
	TYPE 2 DM	Count	32	50	82
		% within type of DM	39.0%	61.0%	100.0%
Total		Count	42	58	100
		% within type of DM	42.0%	58.0%	100.0%

P=0.198

T1 DM had been cross tabulated with T2 DM with respect to clinical findings suggestive of trigger finger (TF) to evaluate the prevalence of TF as shown in table below:

Table 9. show type of DM and trigger finger.

			TRIGGER FINGER		
			POSITIVE	NEGATIVE	Total
ype of DM	TYPE 1 DM	Count	2	16	18
		% within type of DM	11.1%	88.9%	100.0%
	TYPE 2 DM	Count	16	66	82
		% within type of DM	19.5%	80.5%	100.0%
Total		Count	18	82	100
		% within type of DM	18.0%	82.0%	100.0%

P=0.401

Discussion

The musculoskeletal system may be affected by diabetes in various ways. The metabolic perturbations in diabetes such as glycosylation of proteins; micro-vascular abnormalities;damage to blood vessels and nerves; and collagen accumulation in skin and periarticular structures) result in changes in the connective tissue [3]. The present study states that the incidence of rheumatological diseases such as frozen shoulder, SHS, DHS, Dupuytren's contracture and DISH occurred commonly in the diabetic population especially T2DM.

The interrelation ship of diabetes and frozen shoulder is stated clearly. An incidence reported by Bridgmen showed that 11% among diabetics with 78% T2DM and 22% in T1DM[29]. In this study the prevalence ofFS12 % in diabetics more common in T2DM 85%, T1DM 15% and this result was agreement with Bridgmen results.

DHS was reported by Jung etal[32]in adult diabetics and Grgicet al[33] in paediatric diabetics.The study of Kapoor A,Sibbitt WL Jr and et alsuggest a prevalence of about35%,in which T2DM 70% and T1DM 30% [34]. In this study the prevalence of 16.8%, out of which 75% were Type 2and 25%type 1and this was statistically significant.Moreover,the present study has a linear correlation with duration of disease,type of DM,being greater in diabetics of more than 9 years duration. Also, this result agreed with study of Seibold et al [36].

SHS is a unique feature in diabetics and statistically not significant in our study. Association with diabetes was stated by Stein-brocker and Argyros in 15%, T2DM 65% and T1DM 35%[30]. In this study an increased prevalence in DM at 12% (75% T2DM,30%

T1DM) that agree with result of Stein-brocker and Argyros.

Dupuytren's contracture, Crisp AJ, Heathcoate JG studies have reported a prevalence of 21% in diabetics in which were T2DM 77% and T1DM 22%[28]. In this study a prevalence of 4.8%, out of which 65% were of Type 2diabetes and35% T1DM. In contrast,.Holt reported that 25% of patients with Dupuytren's contracture had diabetes[28].This significant result which consistent with studies of Crisp AJ, Heathcoate JG.

A positive correlation is noticed between Osteoarthritis and diabetes.Crisp and Heathcoate showed higher prevalence in diabetic young and middle aged patients. Furthermore, the damage of joint starts earlier and is much more severe[3]. In this study, OA was observed in 40% among diabetic patients,OA of knee51.6%, hip8.1% and spine 16.1%,hand 12.9%,mixed 11.3%,although were statistically significant but inconsistent with Heathcoat study[3].

In this study, hyperostosis of spine was noted, that found DISH was statistically significant and its prevalence 6.4%,in T2 DM 65% and T1DM 35%, consistent with the study conducted by Holt, it showed that its prevalence was25% amongst diabetic patients were found T2DM 83% and T1DM 17%[28].

Charcot joint which involves footwas noticed in 0.8% diabetic patients(only T2DM) and statistically not significant,but no case reported in (T1DM), this findings disagreement with study by Crisp AJ,Heathcoate,as this finding can be explained by the mean age of participant in our study was 50 years old, while Crisp AJ, Heathcoate in their study mean age above 85[3].

The relation of DM durations and diabetic patient's age with joint manifestations was statistically important, agree with results of Pertu et al [1].

Conclusion

The musculoskeletal system is commonly affected by Diabetes mellitus, leading to sharp morbidity. These signs may be unidentified or overlooked in daily clinical preparation. Anyhow, these rheumatological complications can be curable (treatable to varying degrees), with subsequent increases in life quality and more individuality in daily activities.

Recommendations

1. Internist have to be attentive to the potential musculoskeletal complications of diabetes to interfere and provide the best care for affected patients.
2. Attempting to get some enquiries from patients about their disease symptoms and observing the signs of musculoskeletal complications which can be a vital part of total diabetes' care.
3. The management must be directed to blood sugar control and regular exercises.

REFERENCES

1. Crisp, A. J. (1986). Diabetes mellitus and the rheumatologist. https://doi.org/10.1093/rheumatology/25.2.135.
2. Kroop, S. F., & Lee, S. S. (1994). Joint and bone manifestations of diabetes mellitus in Joslin's Diabetes Mellitus 13th Ed; C Ronal Kahn, Gordon C Weir. *Editors Pennsylvania, Lea & Febiger*, 912-917.
3. Crisp, A. J., & Heathcote, J. G. (1984). Connective tissue abnormalities in diabetes mellitus. *Journal of the Royal College of Physicians of London*, *18*(2), 132.
4. Gray, R. G., & Gottlieb, N. L. (1976, August). Rheumatic disorders associated with diabetes mellitus: literature review. In *Seminars in arthritis and rheumatism* (Vol. 6, No. 1, pp. 19-34). WB Saunders. https://doi.org/10.1016/S0049017276)80003-0.

5. Reeves, B. (1975). The natural history of the frozen shoulder syndrome. *Scandinavian journal of rheumatology*, *4*(4), 193-196. https://doi.org/10.3109/03009747509165255.
6. Forgács, S. S. (1994). Endocrine and hemoglobin arthropathies: diabetes mellitus. *Rheumatology. London: Mosby-Yearbook Europe Ltd.*
7. Griggs, S. M., Ahn, A., & Green, A. (2000). Idiopathic adhesive capsulitis: a prospective functional outcome study of nonoperative treatment. *JBJS*, *82*(10), 1398.
8. Bridgman, J. F. (1972). Periarthritis of the shoulder and diabetes mellitus. *Annals of the rheumatic diseases*, *31*(1), 69. https://dx.doi.org/10.1136%2Fard.31.1.69.
9. Balci, N., Balci, M. K., & Tüzüner, S. (1999). Shoulder adhesive capsulitis and shoulder range of motion in type II diabetes mellitus: association with diabetic complications. *Journal of Diabetes and its Complications*, *13*(3), 135-140. https://doi.org/10.1016/S1056872(99)00037-9.
10. Arkkila, P. E., Kantola, I. M., Viikari, J. S., & Rönnemaa, T. (1996). Shoulder capsulitis in type I and II diabetic patients: Association with diabetic complications and related diseases. *Annals of the rheumatic diseases*, *55*(12), 907-914. http://dx.doi.org/10.1136/ard.55.12.907.
11. Gamstedt, A. (1993). Hand abnormalities in patients with NIDDM. *Prog Diabetes*, *4*, 1-6.
12. 12- Rosenbloom, A. L. (2003). Connective tissue disorders in diabetes. *International textbook of diabetes mellitus*. 1517–31. https://doi.org/10.1002/0470862092.ch0912.
13. Starkman, H. S., Gleason, R. E., Rand, L. I., Miller, D. E., & Soeldner, J. S. (1986). Limited joint mobility (LJM) of the hand in patients with diabetes mellitus: relation to chronic complications. *Annals of the rheumatic diseases*, *45*(2), 130-135. http://dx.doi.org/10.1136/ard.45.2.130
14. Eadington, D. W., Patrick, A. W., & Frier, B. M. (1991). Association between connective tissue changes and smoking habit in type 2 diabetes and in non-diabetic humans. *Diabetes research and clinical practice*, *11*(2), 121-125.
15. https://doi.org/10.1016/0168-8227(91)90101-I
16. Noble, J., Heathcote, J. G., & Cohen, H. (1984). Diabetes mellitus in the aetiology of Dupuytren's disease. *The Journal of bone and joint surgery. British volume*, *66*(3), 322-325. https://doi.org/10.1302/0301620X.66B3.6725338
17. Forgacs, S. S. (1986). Diabetes mellitus and rheumatic disease. *Clinics in rheumatic diseases*, *12*(3), 729-753.
18. Gudmundsson, K. G., Arngrı msson, R., Sigfússon, N., Björnsson, Á., & Jónsson, T. (2000). Epidemiology of Dupuytren's disease: clinical, serological, and social assessment. The Reykjavik Study. *Journal of clinical epidemiology*, *53*(3), 291-296. https://doi.org/10.1016/S0895-4356(99)00145-6.
19. Jung, Y., Hohmann, T. C., Gerneth, J. A., Novak, J., Wasserman, R. C., D'Andrea, B. J., ... & Danowski, T. S. (1971). Diabetic hand syndrome. *Metabolism*, *20*(11), 1008-1015. https://doi.org/10.1016/0026-0495(71)90023-0
20. Stevens, J. C., Sun, S., Beard, C. M., O'fallon, W. M., & Kurland, L. T. (1988). Carpal tunnel syndrome in Rochester, Minnesota, 1961 to 1980. *Neurology*, *38*(1), 134-134. https://doi.org/10.1212/WNL.38.1.134
21. Deal, C. (1998). The Endocrine System: Oxford Textbook of Rheumatology.
22. 282–5.

23. Leden, I., Schersten, B., Svensson, B., & Svensson, M. (1983). Locomotor system disorders in diabetes mellitus: increased prevalence of palmar flexortenosynovitis. *Scandinavian journal of rheumatology*, *12*(3), 260-262. https://doi.org/10.3109/03009748309098546.

24. Leden, I., Svensson, B., Sturfelt, G., & Scherstén, B. (1980). Preliminary Report:'Rheumatic Hand Symptoms as a Clue to Undiagnosed Diabetes Mellitus. *Scandinavian Journal of Rheumatology*, *9*(2), 127-128. https://doi.org/10.3109/03009748009098142.

25. Kozin, F. (1992). Reflex sympathetic dystrophy syndrome: a review. *Clinical and experimental rheumatology*, *10*(4), 401-409.

26. Marshall, A. T., & Crisp, A. J. (2000). Reflex sympathetic dystrophy. *Rheumatology*, *39*(7), 692-695. https://doi.org/10.1093/rheumatology/39.7.692

27. Lipson, S. J. (1997). Low back pain. Textbook of rheumatology.

28. Bland, J. H., Frymoyer, J. W., Newberg, A. H., Revers, R., & Norman, R. J. (1979, August). Rheumatic syndromes in endocrine disease. In *Seminars in arthritis and rheumatism* (Vol. 9, No. 1, pp. 23-65). WB Saunders. https://doi.org/10.1016/0049-0172(79)90002-7

29. Bayne, O., & Lu, E. J. (1998). Diabetic Charcot's arthropathy of the wrist. Case report and literature review. *Clinical orthopaedics and related research*, (357), 122-126. https://doi.org/10.1097/00003086-199812000-00016

30. Bridgman, J. F. (1972). Periarthritis of the shoulder and diabetes mellitus. *Annals of the rheumatic diseases*, *31*(1), 69. https://dx.doi.org/10.1136%2Fard.31.1.69

31. Steinbrocker, O. (1947). The shoulder-hand syndrome: Associated painful homolateral disability of the shoulder and hand with swelling and atrophy of the hand. *The American journal of medicine*, *3*(4), 402-407. https://doi.org/10.1016/0002-9343(47)90170-8

32. Steinbrocker, O., & Argyros, T. G. (1958). The shoulder-hand syndrome: present status as a diagnostic and therapeutic entity. *Medical Clinics of North America*, *42*(6), 1533-1553. https://doi.org/10.1016/S0025-7125(16)34203-1

33. Jung, Y., Hohmann, T. C., Gerneth, J. A., Novak, J., Wasserman, R. C., D'Andrea, B. J., ... & Danowski, T. S. (1971). Diabetic hand syndrome. *Metabolism*, *20*(11), 1008-1015. https://doi.org/10.1016/0026-0495(71)90023-0

34. Grgic, A., Rosenbloom, A. L., Weber, F. T., Giordano, B., Malone, J. I., & Shuster, J. J. (1976). Joint contracture—common manifestation of childhood diabetes mellitus. *The Journal of pediatrics*, *88*(4), 584-588. https://doi.org/10.1016/S0022347676(80011-X

35. Kapoor, A., & Sibbitt Jr, W. L. (1989, February). Contractures in diabetes mellitus: the syndrome of limited joint mobility. In *Seminars in arthritis and rheumatism* (Vol. 18, No. 3, pp. 168-180). WB Saunders. https://doi.org/10.1016/0049-0172(89)90059-0

36. Rosenbloom, A. L., Silverstein, J. H., Lezotte, D. C., Richardson, K., & McCallum, M. (1981). Limited joint mobility in childhood diabetes mellitus indicates increased risk for microvascular disease. *New England Journal of Medicine*, *305*(4), 191-194.

37. Seibold, J. R. (1982). Digital sclerosis in children with insulin-dependent diabetes mellitus. *Arthritis & Rheumatism: Official Journal of the American College of*

Rheumatology, *25*(11), 1357-1361. https://doi.org/10.1002/art.1780251112

38. Chang, K., Uitto, J., Rowold, E. A., Grant, G. A., Kilo, C., & Williamson, J. R. (1980). Increased collagen cross-linkages in experimental diabetes: Reversal by β-aminopropionitrile and d-penicillamine. *Diabetes*, *29*(10), 778-781. https://doi.org/10.2337/diacare.20.10.778
39. Kim, R. P., Edelman, S. V., & Kim, D. D. (2001). Musculoskeletal complications of diabetes mellitus. *Clinical diabetes*, *19*(3), 132-135. https://doi.org/10.2337/diaclin.19.3.132