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ORIGINAL ARTICLE

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The musculoskeletal complications seen in type II diabetics: predominance of hand involvement

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Abstract The musculoskeletal complications of diabetes mellitus (DM), which are the most common endocrine arthropathy, have been generally ignored and poorly treated compared with other complications such as neuropathy, retinopathy and nephropathy. Like other quality of life issues, the musculoskeletal disability of DM has not been investigated effectively. The incidence of diabetic foot has decreased thanks to excellent foot care, but the hand is still an important target for diabetic complications. The aim of this study was to investigate early diabetic musculoskeletal complications on the basis of a collaborative multidisciplinary study design. For this purpose 78 patients (mean age 57.8 ± 11.9 years, 55 women and 23 men) who had type II DM for 15 years maximally and 37 non-diabetic controls (mean age: 55.7 ± 11.5, 27 women and 10 men) were randomly selected for inclusion in the study. All patients were evaluated by the Rheumatology, Orthopedic Rehabilitation and Hand Rehabilitation Divisions. Dupuytren's disease was present in 17 (21.8%) of 78 diabetic subjects as the most frequent and statistically significant complication of the musculoskeletal system. In correlation and logistic regression analysis, only retinopathy was significantly associated with duration of diabetes and diabetic foot. Long-term prospective randomised controlled trials on the effects of exercise in preventing musculoskeletal complications and disability in diabetics are needed.

Keywords Arthritis · Complications · Diabetes mellitus · Diabetic foot · Disability · Hand

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Introduction

Diabetes mellitus (DM) is associated with an increased incidence of functional disability, which is likely to further erode health status and quality of life. In several epidemiological studies it has been reported that arthritis, obesity, older age, coronary and peripheral vascular disease, nephropathy, neuropathy, retinopathy, stroke, depression, and cognitive impairment are predictors of disability seen in diabetics [1–9].

There are a wide variety of diabetic complications involving bones, joints and periarticular soft tissues [10]. The upper extremity complications, known as 'diabetic hand', include not only more specific diabetic-related conditions such as limited joint mobility (LJM), but conditions related to the non-diabetic hand, such as trigger finger, Dupuytren's disease (DD) and carpal tunnel syndrome (CTS) [11–30].

The lower extremity complications include Charcot's arthropathy, diabetic foot and osteomyelitis. Although their incidence is decreased, these complications are more serious than diabetic hand complications [10, 31–36].

Other complications, including diabetic amyotrophy and diffuse idiopathic skeletal hyperostosis (DISH), are also painful and disabling disorders. Both proximal upper and lower extremity muscles, and sometimes the paraspinal muscles, are involved in diabetic amyotrophy [37, 38]. DISH is frequently seen in patients with metabolic syndromes such as DM [39–41].

Most previous studies of the association between diabetes and musculoskeletal complications have not included a control group [12, 24, 42, 43] or have included only a single musculoskeletal complication [12, 13, 15–24, 27, 28, 32, 35–43]. The aim of this study was to show changing musculoskeletal involvement, the predominance of the upper extremity, to evaluate associations with other complications, and to suggest preventive measures and exercises in type II diabetics.

Materials and methods

The randomised sample consisted of 78 type II diabetic patients (mean age 57.8 ± 11.9, 55 women and 23 men) attending the Ankara Education and Research Hospital, Department of Endocrinology, Division of Diabetes. A non-diabetic randomised control group (mean age 55.7 ± 11.5, 27 women and 10 men) were selected from the Ankara Education and Research Hospital, Department of Physical Medicine and Rehabilitation, Division of Rheumatology.

After giving informed consent 115 consecutive patients (78 diabetic patients) participated in the study.

The demographic and clinical characteristics of the patients with and without DM are shown in Table 1. The clinical characteristics of the patients, including age, duration of DM, means of the fasting blood glucose levels in last 3 months, nephropathy and neuropathy, were obtained from chart review. The state of the retina was assessed by an experienced ophthalmologist using fundoscopy after dilation of the pupils with a mydriatic agent at the same hospital. The musculoskeletal physical examination focused on the upper and lower extremity and thoracic spine abnormalities.

Hand and shoulder problems (LJM, DD, trigger finger, CTS, adhesive capsulitis and diabetic shoulder girdle amyotrophy) were evaluated by the same investigator on the basis of the Hand Rehabilitation Unit.

LJM was assessed by the 'Prayer sign': patients were asked to bring the palmar surfaces of the fingers together in a praying position with the fingers fanned and the wrist maximally flexed. Failure of metacarpophalangeal or proximal interphalangeal joints to make contact was classified as a positive prayer sign, which means LJM [11].

The diagnosis of DD was made based on the observation of one or more of the following four features on examination: a palmar or digital nodule, tethering of the palmar or digital skin, a pretendinous band and a digital flexion contracture [11].

Trigger finger or flexor tenosynovitis was diagnosed by palpating a nodule or thickened flexor tendon with locking phenomenon during extension and flexion of any fingers [11].

The presence of CTS was defined as pain and paresthesiae of the first, second and third fingers, a positive Phalen sign, and Semmes–Weinstein monofilament test for sensory deficit of the median nerve. The diagnosis of CTS was confirmed with electromyographic nerve conduction studies [11].

Adhesive capsulitis of the shoulder was considered to be present when unilateral unremitting and severe shoulder pain and disability had been present for over 6 weeks, and the shoulder range of motion (ROM) in all planes was less than 33% of contralateral shoulder ROM.

Lower extremity problems (Charcot foot, osteomyelitis and diabetic thigh amyotrophy) and DISH were evaluated by the same investigator on the basis of the Orthopedic Rehabilitation Unit.

Diabetic foot, Charcot foot and osteomyelitis were diagnosed by acute, inflammatory swelling and characteristic laboratory and radiographic features [10].

Diabetic amyotrophy was defined as a severe painful and atrophic shoulder girdle, or thigh and/or back muscles. This diagnosis was confirmed with neuropathic electromyographic findings.

Four-channel EMG Navigator model 663 electromyography apparatus was used for the diagnosis of CTS, diabetic amyotrophy and diabetic sensory neuropathy.

The diagnosis of DISH was based on Resnick's criteria, including flowing ossification along at least four continuos vertebral bodies, preservation of the disc space, absence of vacuum phenomena or vertebral body marginal sclerosis, and absence of apophyseal joint ankylosis or sacroiliac joint erosions or fusion [44].

Statistical analysis was performed with one-way analysis of variance (ANOVA), χ^2 test, Student's t-test, Pearson's correlation test, and stepwise logistic regression using SPSS.

Results

Demographic features, including age and sex, were not statistically different in either group. Mean duration of DM was 9.4 years. Approximately 54% of 78 diabetics have used oral antidiabetics, 43% insulin, and the remaining 3% a diabetic diet to control blood glucose levels.

The prevalence and the distribution of the hand and shoulder problems in the diabetic and non-diabetic control groups are summarised in Table 2.

DD was present in 17 (21.8%) of 78 diabetic subjects as the most frequent and statistically significant complication of the musculoskeletal system.

Adhesive capsulitis was a common disorder in both diabetic (12.8%) and non-diabetic (10.8%) patients. Similarly, the prevalence of carpal tunnel syndrome was not statistically significant in either group on the basis of rheumatology outpatients.

Trigger finger or flexor tenosynovitis was the second common and statistically significant (3.8%) upper extremity complication seen in diabetics.

Interestingly, we could not detect any LJM case in our diabetic sample despite its being diabetes specific.

The prevalence and distribution of the lower extremity problems and DISH are shown in Table 3.

Table 1 The demographic characteristics and non-musculoskeletal complications in patients with and without type II diabetes mellitus

Study group (n = 115, 100%)	Patients with DM (n = 78, 67.8%)	Patients without DM (n = 37, 32.2%)	P
Age (years)	57.8 ± 11.9 (32–81)	55.7 ± 11.5 (30–79)	> 0.01
Sex: Women (% of total)	70.5%	73%	> 0.01
Duration of DM (years)	9.4 ± 7.2 (0.1–15)		
Means of fasting blood glucose	221.20 ± 98.1 (102–415)		
Antidiabetic medication	n = 2, 2.6% diet n = 42, 53.8% oral antidiabetics n = 34, 43.6% insulin		
*Retinopathy (% of total)	12.8%	0%	< 0.01
*Neuropathy (% of total)	12.8%	0%	< 0.01
Nephropathy (% of total)	0%	0%	> 0.01

* Statistically significant parameters

Table 2 The prevalance and the distribution of the upper extremity musculoskeletal disorders in patients with and without type II diabetes mellitus

Study group	Patients with DM		Patients without DM		*P*
	n	%	*n*	%	
Limited joint mobility	0	0	0	0	> 0.01
*Dupuytren's disease	17	21.8	1	2.7	> 0.01*
*Trigger finger	3	3.8	0	0	< 0.01*
Carpal tunnel syndrome	1	1.3	1	2.7	> 0.01
Adhesive capsulitis	10	12.8	4	10.8	> 0.01
*Total	31	39.7	7	16.2	< 0.01*
Shoulder flexion	171.1 ± 25.5		175.2 ± 20.1		> 0.01
Shoulder abduction	170.5 ± 27.8		170.7 ± 25.4		> 0.01
Shoulder rotation	85.6 ± 12.9		85.5 ± 9.5		> 0.01

* Statistically significant parameters

Table 3 The prevalance and the distribution of the lower extremity musculoskeletal disorders and DISH in patients with and without type II diabetes mellitus

Study group	Patients with DM		Patients without DM		*P*
	n	%	*n*	%	
*Diabetic foot	5	6.4	0	0	< 0.01*
*Osteomyelitis	1	1.3	0	0	< 0.01*
Charcot joint	0	0	0	0	> 0.01
Septic arthritis	0	0	0	0	> 0.01
*Amyotrophy	5	6.3	0	0	< 0.01*
*Total	11	13.9	0	0	< 0.01*
DISH	8	10.3	3	8.1	> 0.01

*Statistically significant parameters

Diabetic foot, osteomyelitis and diabetic amyotrophy were present in five (6.4%), one (1.3%) and five (6.4%) of 78 type II diabetic patients, respectively, as the most frequent and statistically significant lower extremity complications.

Among other complications, retinopathy and neuropathy were detected in 10 (12.8%) of 78 type II diabetics.

In correlation and logistic regression analysis, only retinopathy was significantly associated with duration of diabetes and diabetic foot.

Discussion

In addition to micro-and macroangiopathic complications, DM is also associated with several musculoskeletal disorders. Musculoskeletal disorders of the hand and shoulder occur more commonly in diabetic patients. In our study, these syndromes were about twice as frequent in diabetic than non-diabetic patients on the basis of the rheumatology practices. Caglieri et al. reported that hand and shoulder problems were increased fourfold in diabetics compared with non-diabetic controls on the basis of primary care practices [13].

This is the first study to involve all diabetic musculoskeletal complications on the basis of rheumatology, with the collaboration of the rheumatologist, hand and orthopaedic rehabilitation specialists.

The hand in particular is an important target for diabetic complications. Hand involvement, limited joint mobility syndrome, Dupuytren's contracture and trigger finger probably have the same pathogenesis and are caused by excessive glycosylation of collagen in the skin and periarticular structures, and by decreased removal of degenerated collagen, resulting in thick, inelastic tissues [10, 14].

Limited joint mobility (LJM), also termed diabetic stiff hand syndrome or diabetic cheiroarthropathy, is characterised by skin thickening over the dorsum of the hands and restricted mobility of multiple joints. LJM is usually painless and not disabling [10–20] and occurs in 30% or more of patients with long-standing diabetes [22]. We did not detect LJM in our sample group. It may depend on the duration of DM, which was under 10 years in most of our patients. Several studies have suggested that LJM is predictive of renal, retinal and other diabetic complications [14, 20].

As another hand involvement, DD is a spontaneously occurring chronic and idiopathic thickening of the palmar aponeurosis, leading to various degrees of flexion deformity of the fingers. DD may be seen in patients with DM, epilepsy and alcoholic liver disease [12–22]. Unlike most cases of LJM, DD may be seen relatively early in the course of the disease, with a 30 % prevalence [22]. Twenty-two per cent of type II diabetics in our study had DD.

Arkkila et al. reported that the patient's age and duration of diabetes are the most important factors predicting the development of DD in type I diabetic patients after 5 years follow-up [12]. In several studies a correlation between DD and microvascular complications such as neuropathy, retinopathy and nephropathy has been reported [19, 20, 45, 46]. We could find no correlation between DD and microvascular complications in our cross-sectional study. Similarly, Arkkila and Caglieri found that the presence of DD did not predict the development of retinopathy or other diabetic complications in their respective prospective and cross-sectional studies [12, 13].

Trigger finger, a catching and snapping of the fingers, occasionally painful, is also frequent in diabetic patients and is due to flexor tenosynovitis. We found an increased frequency of trigger finger compared with controls, as reported in other studies [13, 22–24].

Although lower extremity complications are markedly diminished by good control of blood glucose and excellent foot care, they remain important because of their difficulty of treatment [31–36].

Diabetic foot especially is a major problem in longstanding diabetics with peripheral sensory neuropathy. Similarly, Charcot joint occur in persons with sensory neuropathy. The routine use of diabetic neuropathy drugs such as gabapentin has decreased neuropathic complications [47].

Only 7.7 % of our patients had a diabetic foot and osteomyelitis. This low frequency may depend on the duration of DM, which was relatively shorter than in the literature [31–36], or on successful foot care.

Diabetic amyotrophy, a rare neuropathic atrophy of proximal muscles, generally resolves slowly. This problem may lead to disturbances of standing balance and gait. Assistive devices such as crutches or a cane may be required.

Gregg et al. found that older women with DM were twice as likely as their non-diabetic counterparts to become unable to perform physical and household tasks: the annual incidence in their 10-year prospective cohort study of disability was approximately 10% among those with DM [1]. They also found several potentially modifiable factors, including obesity, coronary heart disease, physical inactivity and arthritis, to be associated with the onset of disability among women with DM. We evaluated only one of them: arthritis.

Physical activity interventions, including strength and posture/balance training and walking, have been associated with improved physical functioning and good control of blood glucose in patients with DM [48].

In the hand, the range of motion (ROM), the flexor tendon stretching and gliding exercises, shoulder ROM, stretching and strengthening exercises may be useful for prevention of diabetic hand/shoulder complications.

In the foot, good hygiene, ankle ROM and stretching of the plantar fascia, lower extremity stretching and quadriceps strengthening exercises should be prescribed for each diabetic patient.

In addition, aerobic exercise programmes at least four times weekly with low to moderate (50%–85% of VO_{2max}) intensity, 20 min/set, are recommended by the American College of Sports Medicine to control blood glucose levels, to reduce the need for oral antidiabetics or insulin, to prevent obesity and coronary heart disease, and finally to reduce disability [48].

Because of autonomic neuropathy, exercise teams should be aware of silent ischaemia, postural hypotension and/or blinded heart rate response in diabetics [8,48]. It should prefer the use of an arm ergometer and modified exercise protocols, and rate of perceived exertion scale (Borg scale 11–13) instead of maximal heart rate response [85% × (220-age)] in diabetics with peripheral vascular disease.

We need long-term prospective randomised controlled trials on the effects of exercise in the prevention of musculoskeletal complications and disability seen in diabetics.

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