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Research Paper

Comparison of Joint Range Of Motion Of Upper Extremities And Hand Grip Strength In Patients With Type II Diabetes Mellitus And Non Diabetic Individuals

Medical Science

KEYWORDS : limited joint mobility, hand grip strength, Diabetes Mellitus Type II, Jamar dynamometer.

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ABSTRACT

Title: Comparison of Joint Range Of Motion Of Upper Extremities And Hand Grip Strength In Patients With Type II Diabetes Mellitus And Non Diabetic Individuals

Introduction : Diabetes is a progressive chronic disease associated with various complications. The musculoskeletal complications like limited joint mobility and reduced hand grip strength reduce the functional levels of the individual.

Aim :To compare upper extremity range of motion and hand grip strength in diabetics and non diabetics.

Method: After taking permission of the College ethical Committee and informed consent, 60 subjects (age= 40 to 60 years) were sampled into two groups of diabetics and non diabetics. The author assessed passive range of motion of bilateral upper extremities, Table Top test, and hand Grip Strength.

Result: There was statistically significant restriction in right shoulder flexion, abduction, medial rotation and lateral rotation, supination, radial and ulnar deviation of diabetic subjects ($p<0.05$). There was statistically significant reduction in mean hand grip strength of diabetic subjects ($p<0.05$).

Conclusion: Type II diabetes mellitus significantly affects range of motion and hand grip strength.

INTRODUCTION:

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia caused by absolute or relative deficiency of insulin.

The primary cause for insulin resistance remains unclear. Intra-abdominal 'central' adipose tissue is metabolically active, and releases large quantity of free fatty acids which may induce insulin resistance because they compete with glucose as a fuel supply for oxidation in peripheral tissues such as muscle.[1]

Insulin affects the synthesis and degradation of all types of collagen and proteoglycans of connective tissue. In diabetes mellitus type II there is impaired degradation and non-enzymatic glycosylation of collagen due to insulin resistance and hyperglycemia. This leads to excessive accumulation and increased cross linking of collagen on the skin and around the joint capsule. This alters the structural matrix and mechanical properties of these tissues leading to diffuse arthrofibrosis [2,3]

This abnormal collagen metabolism results in many musculoskeletal manifestations like cheiroarthropathy, frozen shoulder, dupuytren's contracture and trigger finger.

Muscle weakness because of insulin resistance and hyperglycemia cause a reduction in number of mitochondria in muscle cells, a decrease in glycogen synthesis and an increase in amount of circulating inflammatory cytokines, all of which have a detrimental effect on skeletal muscles leading to their weakness.[4] Thus weakness of skeletal muscles can be clinically seen in the form of reduced hand grip strength.

Thus limited joint mobility and reduced grip strength which are purely preventable will help the physiotherapist's to plan early interventions for the complications and prevent their occurrence.

AIM:

- To compare upper extremity joint range of motion and hand grip strength in patients with Diabetes mellitus Type II and normal subjects.

OBJECTIVES:

- To assess the effect of diabetes mellitus on joint range of motion of upper extremities.
- To assess the effect of diabetes mellitus on hand grip strength.
- To assess the effect of dominance on joint range of motion of diabetics as against non diabetics.

sMETHODOLOGY:

Study Design: Experimental study

Sample Size:

Group1= 30 patients with diabetes mellitus,

Group 2= 30 non diabetic healthy adults.

Sampling technique: Convenient Sampling.

Place of study: Diabetic subjects attending outpatient departments at various hospitals. Non diabetic subjects were taken from housing societies

Inclusion criteria:

Patients in the age group 40-60 years with minimum 5 years duration of type II diabetes mellitus.[1,5]

Exclusion Criteria:

- Rheumatoid arthritis.
- Neuropathy or symptoms of neuropathy.
- Thyroid malfunctions
  vCollagen disease.
- Any fractures or dislocations of upper limb.
  vIndividual should not be involved in any occupation or sports that may provide an advantage of better hand grip.

Methodology:

- After obtaining approval from college ethical committee and written consent, the study was started.
- Subjects were selected on the basis of inclusion and exclusion criteria.
- In case of non diabetic subjects a random glucose test was performed using the glucometer.
  vSubjects having random glucose level above 120 mg/dl were excluded from the study in order to avoid selection of subjects who had undiagnosed diabetes mellitus.
- Then the passive range of motion of bilateral upper extremities was measured using goniometry .[6,7]

- The Table Top test was performed where subjects were asked to flatten their both hands on the table. If any of the interphalengeal or metacarpophalengeal joints were not touching the table the test was considered to be positive and number of joints not touching the table were counted.
- Hand Grip Strength assessment was done according to the position given by American Association of Hand Surgeons. Subjects were seating on a stool of comfortable height with

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no backrest or armrest. Forearm was in a midprone position. The patients were asked to press the handle with maximum force. The subjects were given [3] attempts and a mean of the 3 attempts was considered[8]

STATISTICAL ANALYSIS:
For numerical data, students't-test (two samples assuming unequal variances) was applied to the data and interpretation of significance was done.

For the non numerical data, Z test with unequal variances was applied and interpretation of significance was done.

TABLE 1: RANGE OF MOTION
Table 1a: Range of motion for right side

Joint ROM RT	Mean for Diabetics	Mean for Non diabetics	Calculated t test value	p value	Interpretation
Sh flex[n]	172.2	180	-2.22	0.01	Significant
Sh ext[n]	50	51.6	-1.56	0.06	Non significant
Sh Abd[n]	171.33	180	-2.51	0.00	Significant
Sh Lat rot[n]	72.66	85	-2.94	0.03	Significant
Sh Med rot[n]	74.33	90	-2.73	0.05	Significant
Elbow flex[n]	119.67	120	-0.15	0.29	Non significant
RU Supin[n]	79.83	85	-7.39	$1.87E^{-08}$	Significant
Wrist flex[n]	80	80.33	-0.52	0.29	Non significant
Wrist ext[n]	86.33	87	-0.53	0.29	Non significant
Wrist RD	14.83	20	-6.09	$6.06E^{-07}$	Significant
Wrist UD	20.5	30	-5.47	$3.37E^{-08}$	Significant

Interpretation of Table 1a : There is a statistically significant reduction in right side shoulder flexion, abduction, medial rotation and lateral rotation in diabetics as compared to non diabetics at $p < 0.05$. There is a statistically significant reduction in bilateral supination, wrist radial and ulnar deviation in diabetics as compared to non diabetics at $p < 0.05$

TABLE 2: MEAN HAND GRIP STRENGTH

MEAN HAND GRIP STRENGTH	DIABETICS	NON DIABETICS	Calculated value(t test)	p value	Interpretation
Right Side	43.60	81.04	-9.19	$4.2E^{-12}$	Highly Significant
Left Side	43.70	78.39	-8.53	$1.74E^{-12}$	Highly Significant

Interpretation of Table 2: There is a statistically significant reduction in mean hand grip strength of both the sides in diabetics as compared to non diabetics at $p < 0.05$

Table 3: Table top Test

TABLE TOP TEST	DIABETICS	NON DIABETICS
POSITIVE	09	0
NEGATIVE	21	30

Z=3.25

P=0.000

Interpretation of table 3: There is a significant increase in table top test of diabetics versus non diabetics at $p<0.05$

DISCUSSION:
Diabetes is known to be associated with various musculoskeletal manifestations like frozen shoulder, dupuytren's contracture, trigger finger ,carpal tunnel syndrome, reflex sympathetic dystrophy, and neuropathic or Charcot's joints.[3,4,5,9]

The glucose-protein duct can act as cross links, resulting in altered mechanical properties of collagen. Insulin affects the synthesis and degradation of all types of collagen and proteoglycans of connective tissue. Evidence suggests that the diabetic hyperglycemic state leads to an increase in non enzymatic glycosylation, causing increased cross-linking of collagen. [13,14] This increased glycosylation level would permit increased collagen cross-linking and alter the turnover of collagen by causing tissues to be less susceptible to digestion by collagenases.13 The accumulation of collagen, seen histologically in the lower dermis, may lead to clinical manifestations such as scleroderma-like skin changes and may cause periarticular stiffness that is thought to result in limited joint mobility.[13,14]

Although the patients were right side dominant a greater restriction is found in the right side. The probable cause is impaired collagen metabolism which leads to increased collagen deposition in shoulder joint capsule. However no restriction in shoulder extension and adduction suggests that collagen deposition is not uniform around the capsule. It can also be seen that the range of motion for non diabetic subjects is almost full. Nancy Ingersoll Shinabarger found that subjects with diabetes mellitus had a significant decrease ($p<0.05$) in AROM when compared with controls for shoulder abduction and ability to flatten the hand.2 In another study by M. A. Fitzcharles et al observed restricted range of motion in 36 NIDD patients but only 7 controls ($p<0.01$)[9]

The mean hand grip strength was significantly reduced in diabetics as compared to non diabetics bilaterally. Insulin resistance and hyperglycemia may lead to depletion of mitochondria in the muscle cells which further reduces the glycogen synthesis. Thus there is an increase in the amount of circulating inflammatory cytokines and results in weakness of the skeletal muscles.7 American Diabetes Association, June 2006, also found the same.

Table top test was used to measure the presence of dupuytrens' contracture in the palmar fascia of the hands. The probable cause could be fibro-proliferation of connective tissue of the palmar aspect of the hands due to prolonged insulin resistance and hyperglycemia as result of micro vascular complications of diabetes. M. A. Fitzcharles et al found that limited joint mobility was most prominent in hand but caused no functional impairments.

CONCLUSION:

Type II diabetes mellitus affects the range of motion and hand grip strength of the upper extremities significantly.

Restriction of joint range of motion is more on the same side of dominance.

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