Original Research Article

Impact of Diabetic Neuropathy on Ankle Dorsiflexion in Older Adults

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Abstract

Background: Diabetes mellitus is increasing among the population. If early diagnosis and treatment can be done, complications can be reduced. Although there are studies evaluating the impact of diabetes on joint motion, there are limited studies examining the ankle range of motion and its correlation with duration or severity of diabetic neuropathy symptoms. This study aims to examine the impact of diabetic neuropathy on angle of ankle dorsiflexion and it's correlation with duration or severity of diabetic neuropathy symptoms **Methods:** Descriptive study in Government medical college, Thoothukudi. 72 patients attending the outpatient department of Medicine and Neuromedicine of a tertiary care hospital, ranging from 40 to 75 years were included in the study out of which 36 were diabetic with symptoms of diabetic neuropathy and 36 were non-diabetic. Ankle range of motion was measured using goniometer. Severity of neuropathy assessed using Toronto Clinical Neuropathy score and duration of diabetic neuropathy symptoms recorded. **Results:** Mean Age (Diabetic group) 59.28±8.06 Vs 56.08±10.16 (Non-Diabetic group). Proportion of patients with decreased angle of dorsiflexion among the patients with diabetic neuropathy (77.8%) was significantly higher than non-diabetic patients (47.2%) ($Z=4.52; p<0.0001$). Chi-square (χ^2) test showed that there was significant association between severity of diabetic neuropathy and angle of dorsiflexion (in degree) of the patients with diabetic neuropathy ($p<0.0001$). Angle of dorsiflexion decreased significantly with severity of diabetic neuropathy. Pearson correlation co-efficient showed that there was significant negative correlation between duration of diabetic neuropathy and angle of dorsiflexion ($r=-0.61; p<0.001$). Thus with the increase in duration of diabetic neuropathy angle of dorsiflexion decreased significantly.**Conclusions:** It was found that the angle of ankle dorsiflexion was lower in diabetic patients as compared to non-diabetic patients It was also concluded that the duration of diabetic neuropathy and severity of sensory symptoms have an inverse relationship with ankle range of motion

Keywords: Ankle of dorsiflexion, Diabetes, peripheral neuropathy

Introduction

Diabetes mellitus is increasing among the population. If early diagnosis and treatment can be done, complications can be reduced. The clinical definition of diabetic peripheral sensory neuropathy in which the patients with diabetes experience symptoms such as pain, burning sensation, hyperaesthesia or signs of nerve damage that the patient maybe aware of, mainly the aesthetic or deformed foot.[1]

The pathogenesis varies as per the type of diabetes.The metabolic factors are mainly high blood glucose levels, dyslipidemia, long duration of diabetes and possibly low levels of insulin.[2] Diabetic peripheral neuropathy (DPN)is the most common complication of diabetes mellitus [3,4] leading to motor deficits [5,6], such as reductions in peak muscle strength and changes in muscle activity during walking, mainly for plantar flexor . These changes could lead to a decreased range of motion of the feet and ankles , resulting in walking deficits [7,8]. Although there are studies evaluating the impact of diabetes on joint motion, there are limited studies examining the ankle range of motion and its correlation with duration or severity of diabetic neuropathy

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symptoms. This study aims to examine the impact of diabetic neuropathy on angle of ankle dorsiflexion and it's correlation with duration or severity of diabetic neuropathy symptoms.

Methods

Cross-sectional study in a tertiary care centre (Government Medical College Thoothukudi) in South India. Total study duration of 5 months (June 2022-Oct 2022. 72 patients attending the outpatient department of Medicine and Neuromedicine , ranging from 40 to 75 years were included in the study out of which 36 were diabetic with symptoms of diabetic neuropathy and 36 were non-diabetic. Subjects were included after obtaining informed consent. Evaluation criteria were explained to all the subjects. Data including age, sex, duration of diabetes, other relevant history recorded. Ankle range of motion was measured using goniometer (QAS_K medical goniometer, Bos medicare,India). All measurements were taken on the right lower extremity with the subject lying supine in knee extension. Severity of neuropathy assessed using Toronto Clinical Neuropathy score and duration of diabetic neuropathy symptoms recorded. Statistical Analysis was performed with help of Epi Info (TM) 7.2.2.2 EPI INFO is a trademark of the Centers for Disease Control and Prevention (CDC). Descriptive statistical analysis was performed to calculate the means with corresponding standard deviations (s.d.).The study was conducted after due consideration of all ethical issues.

INCLUSION CRITERIA

1. Patients between age 40-75 years
2. Medically stable patients
3. Both males and females
4. Diabetic patients screened for neuropathy using Toronto Clinical Neuropathy score
5. Informed consent

EXCLUSION CRITERIA

1. Great toe or metatarsal amputation
2. Current/history of foot ulcer
3. Critically ill patients
4. Unco-operative patients
5. Lumbo-sacral polyradiculopathies
6. Other causes of neuropathy except diabetic neuropathy

Results

In this study 72 patients were selected randomly out of the patients attending at Outpatient department of Medicine and neuromedicine at Government Thoothukudi Medical College, Thoothukudi during the period of study. Out of 72 patients 50.0% of the patients were with diabetic neuropathy and rest 50.0% of the patients were non-diabetic. Thus the patients of the two groups were in the ratio 1:1.

t-test showed that there was no significant difference in mean age of the patients of the two groups (t_{70}=1.47;p=0.14). [Mean Age (Diabetic group) 59.28±8.06 Vs 56.08 ± 10.16 (Non-Diabetic group)]. Thus the patients of the two groups were matched for their ages

χ^2 =0.22; p=0.63 NS- Not Significant

Chi-square (χ^2) test showed that there was no significant association between gender and the patients of the two groups (p=0.63). Thus the patients of the two groups were matched for their gender.

χ^2 =0.01; p=0.99 NS- Not Significant

Chi-square (χ^2) test showed that there was no significant association between habit of drinking alcohol and the patients of the two groups (p=0.99). Thus habit of drinking alcohol was equally distributed among the patients of the two groups.

χ^2 =0.64; p=0.42 NS- Not Significant

Chi-square (χ^2) test showed that there was no significant association between habit of

Table-1: Angle of dorsiflexion (in degree) and the patients of the two groups

Angle of dorsiflexion (in degree).	Diabetic	Non-Diabetic	TOTAL
Present Row % Col %	28 62.2 77.8	17 37.8 47.2	45 100.0 62.5
Absent Row % Col %	8 29.6 22.2	19 70.4 52.8	27 100.0 37.5
TOTAL Row % Col %	36 50.0 100.	36 50.0 100.	72 100.0 100.0
Mean±s.d.	-6.67±6.61	-0.53±6.11	
Median	-5.5	0	
Range	-20 - 3	-12 - 10	

smoking and the patients of the two groups (p=0.42). Thus habit of smoking was equally distributed among the patients of the two groups .

χ^2 =2.66; p=0.10 NS- Not Significant

Chi-square (χ^2) test showed that there was no significant association between hypertension and the patients of the two groups (p=0.10). Thus hypertension was equally distributed among the patients of the two groups.

χ^2 =7.17; p=0.007 S-Significant

Chi-square (χ^2) test showed that there was significant association between angle of dorsiflexion and the patients of the two groups (p=0.007).

Proportion of patients with decreased angle of dorsiflexion among the patients with diabetic neuropathy (77.8%) was significantly higher than non-diabetic patients (47.2%) (Z=4.52;p<0.0001).

The risk of decreased angle of dorsiflexion among the patients with diabetic neuropathy was 3.91 times more as compared to non-diabetic patients and the risk was significant [OR-3.91 (1.41, 10.87);p=0.007].

t-test showed that the mean angle of dorsiflexion of the patients with diabetic neuropathy was significantly lower than non-diabetic patients (t_{70}=4.09;p<0.001).

Most of the patients were with mild diabetic neuropathy (38.9%) but it was not significantly higher than moderate diabetic neuropathy (33.3%) and severe diabetic neuropathy (27.8%) (Z=1.49;p=0.13).

Table-2: Severity of diabetic neuropathy

Severity	Number	%
Mild	14	38.9%
Moderate	12	33.3%
Severe	10	27.8%
Total	36	100.0%

Table-3: Duration of diabetic neuropathy

Duration (years)	Number	%
<5	16	44.4%
5 - 9	12	33.3%
≥10	8	22.2%
Total	36	100.0%
Mean±s.d.	6.17±5.51	
Median	5	
Range	1 - 25	

Table-4: Severity of diabetic neuropathy and angle of dorsiflexion (in degree) of the patients with diabetic neuropathy

Severity	Angle of dorsiflexion (in degree)		TOTAL
	Diabetic	Non-Diabetic	
Mild Row % Col %	6 42.9 21.4	8 57.1 100.0	14 100.0 38.9
Moderate Row % Col %	12 100.0 42.9	0 0.0 0.0	12 100.0 33.3
Severe Row % Col %	10 100.0 35.7	0 0.0 0.0	10 100.0 27.8
Total Row % Col %	28 77.8 100.0	8 22.2 100.0	36 100.0 100.0

The mean (±s.d.) duration of diabetic neuropathy was 6.17±5.51 years with range 1 -25 years and the median was 5 years.

Most of the patients were with duration of diabetic neuropathy <5 years (44.4%) but it was not significantly higher than duration of diabetic neuropathy between 5 - 9 years (33.3%) (Z=1.59;p=0.11) but was significantly higher than duration of diabetic neuropathy ≥10 years (22.2%) (Z=3.34;p<0.001).

χ^2 =16.16; p<0.0001 S-Significant

Chi-square (χ^2) test showed that there was significant association between severity of diabetic neuropathy and angle of dorsiflexion (in degree) of the patients with diabetic neuropathy (p<0.0001).

Angle of dorsiflexion significantly decreased with severity of diabetic neuropathy.

Pearson correlation co-efficient showed that there was significant negative correlation between duration of diabetic neuropathy and angle of dorsiflexion (r=-0.61;p<0.001). Thus with the increase in duration of diabetic neuropathy angle of dorsiflexion decreased significantly.

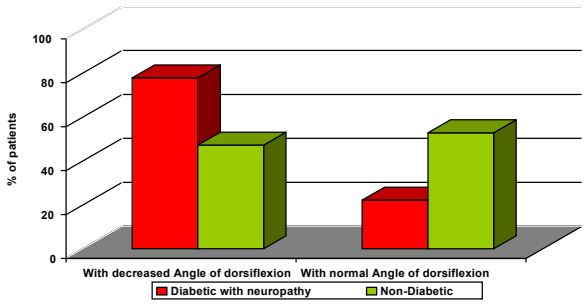

Figure 1

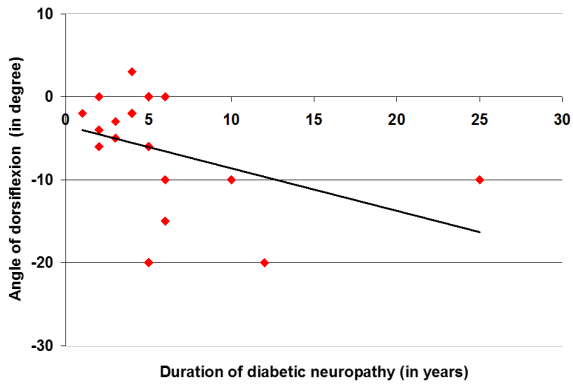

Figure 2

Discussion

Mean age of both the study groups were similar. The mean (±s.d.) duration of diabetic neuropathy was 6.17±5.51 years.22.2 % patients had more than 10 years of diabetes.

The age group which was included in this study has been 40-75 Years. Brigadier AS Kasturi et al. in their study found that the incidence of neuropathy was more in patients above the age of 40 years , especially in those with more than 2 years of diabetes [9].16.7% patients in the diabetic group had hypertension and 16.7% had a history of regular alcohol consumption which can be confounding factors for peripheral neuropathy. Most patients with peripheral neuropathy complained of pain, numbness, tingling sensation and weakness in lower extremities which was assessed using Toronto Clinical Neuropathy Score. [10]

In the present study goniometer was used to measure the range of ankle movement. All the measurements were taken with knee in extension. The values were compared between the diabetic and the non-diabetic group. A study done by Youdas JW et al. on 38 subjects for the goniometric measurements for ankle plantar and dorsiflexion concluded that goniometer is a reliable and valid method of measuring range of motion.[11]

This study showed that ankle range of motion is reduced in diabetics as compared to non-diabetics (table 4). Rao S et al. found that there was decrease in the range of ankle motion due to long standing hyperglycemia [12]. Findings of increased collagen deposition, cross linking, and glycosylation have been described in the thickened skin of subjects with decreased range of joint motion[13].

Toronto clinical neuropathy score [14] was used to assess the severity of diabetic neuropathy symptoms. Most of the patients were with mild diabetic neuropathy (38.9%) but it was not significantly higher than moderate diabetic neuropathy (33.3%) and severe diabetic neuropathy (27.8%). This study showed that there was significant association between severity of diabetic neuropathy and angle of dorsiflexion (in degree) of the patients with diabetic neuropathy (table 4.)

This study showed there was a significant negative correlation between duration of diabetes and angle of dorsiflexion (figure 2). Andre Pfannkuche et al. in their study of risk factors for diabetic neuropathy found that increasing age and duration of diabetes are risk factors for diabetic neuropathy[15].

Exercise can help improve range of motion in diabetics and ensure gait improvement and stability[16]. Thus physiotherapy and good glycemic control can play an important role in reducing joint stiffness in diabetics and must be recommended.

Conclusion

Thus it was concluded that ankle range of motion is lower in diabetics as compared to non-diabetics. Also angle of ankle dorsiflexion has an inverse relationship with severity and duration of diabetic neuropathy.

Limitations

The limitation of this study was that it was conducted in a single tertiary care centre. Multi-centre studies with larger sample sizes are needed to be more conclusive.

Declaration

Conflict of interest- nil

Ethical clearance- Taken from Institutional ethics committee

Source of funding-no funding required

References

1. Ward JD. Diabetic neuropathy. British medical bulletin. 1989 Jan 1;45(1):111-26. Available from: https://doi.org/10.1093/oxfordjournals.bmb.a072307
2. National Institute of Diabetes, Digestive, Kidney Diseases (US). Diabetic neuropathy: the nerve damage of diabetes. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes & Digestive & Kidney Diseases; 1991.
3. Kumar S, Ashe HA, Parnell LN, Fernando DJ, Tsigos C, Young RJ, Ward JD, et al. The prevalence of foot ulceration and its correlates in type 2 diabetic

patients: a population-based study. Diabetic Medicine 1994;11:480–4. Available from: https://doi.org/10.1111/j.1464-5491.1994.tb00310.x

4. Cabezas-Cerrato J. The prevalence of clinical diabetic polyneuropathy in Spain: a study in primary care and hospital clinic groups. Diabetologia 1998;41:1263–9. Available from: https://doi.org/10.1007/s001250051063

5. Boulton AJM, Malik RA, Arezzo JC, Sosenko JM. Diabetic somatic neuropathies. Diabetes Care 2004;27:458–86. Available from: https://doi.org/10.2337/diacare.28.4.956

6. Al-Maskari F, El-Sadig M. Prevalence of risk factors for diabetic foot complications. BMC Family Practice 2007;10(October):8–59. Available from: https://doi.org/10.2337/diacare.28.4.956

7. Allet L,Armand S, Golay A, Monnin D, de Bie RA, de Bruin ED. Gait characteristics of diabetic patients: a systematic review. Diabetes/Metabolism Research and Reviews 2008;24:173–91. Available from: https://doi.org/10.1002/dmrr.809

8. Allet L, Armand S, de Bie RA, Pataky Z, Aminian K, Herrmann FR, et al. Gait alterations of diabetic patients while walking on different surfaces. Gait and Posture 2009;29:488–93. Available from: https://doi.org/10.1016/j.gaitpost.2008.11.012

9. Kasthuri AS, Sofat S, Kumar N. Somatic neuropathy in Diabetes mellitus. Medical Journal Armed Forces India. 2000 Jan 1;56(1):33-6. Available from: https://doi.org/10.1016/S0377-1237(17)30087-4

10. Udayashankar D, Premraj SS, Mayilananthi K, Naragond V. Applicability of Toronto Clinical Neuropathy Scoring and its Correlation with Diabetic Peripheral Neuropathy: A Prospective Cross-sectional Study. Journal of Clinical & Diagnostic Research. 2017 Dec 1;11(12).

11. Youdas JW, Bogard CL, Suman VJ. Reliability of goniometric measurements and visual estimates of ankle joint active range of motion obtained in a clinical setting. Archives of physical medicine and rehabilitation. 1993 Oct 1;74(10):1113-8. Available from: https://doi.org/10.1016/0003-9993(93)90071-H

12. Rao S, Saltzman C, Yack HJ. Ankle ROM and stiffness measured at rest and during gait in individuals with and without diabetic sensory neuropathy. Gait & posture. 2006 Nov 1;24(3):295-301. Available from: https://doi.org/10.1016/j.gaitpost.2005.10.004

13. Starkman HS, Gleason RE, Rand LI, Miller DE, Soeldner JS. Limited joint mobility (LJM) of the hand in patients with diabetes mellitus: relation to chronic complications. Annals of the rheumatic diseases. 1986 Feb 1;45(2):130-5. Available from: http://dx.doi.org/10.1136/ard.45.2.130

14. Bril V, Tomioka S, Buchanan RA, Perkins BA, mTCNS Study Group. Reliability and validity of the modified Toronto Clinical Neuropathy Score in diabetic sensorimotor polyneuropathy. Diabetic Medicine. 2009 Mar;26(3):240-6. Available from: https://doi.org/10.1111/j.1464-5491.2009.02667.x

15. Pfannkuche A, Alhajjar A, Ming A, Walter I, Piehler C, Mertens PR. Prevalence and risk factors of diabetic peripheral neuropathy in a diabetics cohort: Register initiative "diabetes and nerves". Endocrine and Metabolic Science. 2020 Jul 1;1(1-2):100053. Available from: https://doi.org/10.1016/j.endmts.2020.100053

16. Cerrahoglu L, Koşan U, Sirin TC, Ulusoy A. Range of motion and plantar pressure evaluation for the effects of self-care foot exercises on diabetic patients with and without neuropathy. Journal of the American Podiatric Medical Association. 2016 May 1;106(3):189-200. Available from : https://doi.org/10.7547/14-09