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QUANTITATIVE EVALUATION OF GAIT PARAMETERS IN PATIENTS WITH DIFFERENT GRADES OF KNEE OSTEOARTHRITIS USING A PRESSURE MEASURING SYSTEM.

Physiotherapy

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ABSTRACT

Background- Osteoarthritis (OA) is a chronic degenerative condition that affects every component of the afflicted joint and is characterized by focal cartilage loss and periarticular bone response, brought on by an imbalance between cartilage degeneration and regeneration. Patients with knee OA may experience poor balance and gait because of functional deficiencies that would limit their mobility and function. The purpose of the study is to quantitatively evaluate the changes in gait parameters in different grades of knee Osteoarthritis patients which is difficult to define by subjective clinical assessment. **Objective Of The Study-** To quantify and compare the foot COP deviation, pain, clinical scores and disability in normal versus osteoarthritis patients of all grades. **Methodology-** A total of 295 subjects were purposefully assigned to five groups according to Kellgren & Lawrence Criteria. A minimum of 45 subjects were assigned to each group and barefoot pressure measurement was carried out on the ORTHO-KING PRESSURE PLATE SDP 610. Static, dynamic, and multiple dynamic acquisitions were taken to quantify gait parameters such as stance time, pre-stance, mid-stance and terminal stance and location of COP was measured at heel, midfoot, forefoot and toe. **Result -** Data was analyzed using SPSS software. A comparison between five groups was performed to study the significant difference between the groups. Statistical tests such as ANOVA and tukey's pairwise comparison were used for the analysis of data of osteoarthritis patients and normal subjects. **Conclusion-** The study concluded that gait parameters that is foot Center of Pressure deviation, clinical scores, pain, and disability showed statistically significant differences between normal subjects vs Osteoarthritis patients of all grades. It also concluded that average vertical force and COP deviation at mid-foot showed statistically non-significant differences between normal subjects vs Osteoarthritis patients of all grades.

KEYWORDS

INTRODUCTION

Osteoarthritis (OA) is a disabling condition that affects every component of the afflicted joint.[1] It is a chronic degenerative joint disease with exacerbation of acute inflammation which typically affects the articular cartilage leading to new bone formation at the joint surfaces and margins.[2,3] Osteoarthritis (OA) is characterized by focal cartilage loss and periarticular bone response, brought on by an imbalance between cartilage degeneration and regeneration.[4] It is a synovial joint disorder characterized by a failed repair of the joint damage that occurs because of some form of stress which can be any kind of deformity of the synovial joint tissues i.e. articular cartilage, ligaments, menisci, synovium, subchondral bone, peri-articular muscles. It may be a widespread disease or exclusive to one joint.[7]This arthropathy most frequently manifests as joint discomfort, restricted locomotion, and functional impairment of varying degrees.[5] It is the most prevalent musculoskeletal disorder leading to joint disability, functional deterioration, and an overall decline in quality of life and is responsible for 85% of the physical and social burden, and it is anticipated to continue to rise as the population ages and the frequency of obesity rises.[6,7,8,9]The most common type of OA is knee OA, although it can also affect the spine, elbows, hands, hips, feet, temporomandibular joints, and sacroiliac joints.[4,10] Osteoarthritis (OA) of the knee is a prevalent multifactorial joint disease that progresses over time and is marked by functional impairment and chronic discomfort.[11] In 90% of instances, varus deformity is present.[9]

Osteoarthritis of knee has been categorized into: primary and secondary, according to the etiology of its occurrence.[12,13]Primary OA also known as idiopathic or non-traumatic. It occurs in old age, mainly in the weight-bearing joints i.e., knee and hip joints.[12] Primary osteoarthritis is caused by several variables, including obesity, heredity, occupations requiring extended standing, sports, various endocrine problems, and several metabolic disorders.[12]Secondary OA can be seen at any age and is usually secondary to trauma, congenital or developmental disorders.[14] All of these secondary cases involve either an abnormal increase in joint stress or a change in the joint's capacity to resist normal stress. In secondary osteoarthritis, the deterioration of the joint occurs over an extended period and is caused by an underlying primary illness of the joint. Obesity, knee valgus and varus deformities, intra-articular fractures, hyperparathyroidism, excessive intra-articular steroid therapy, syringomyelia, hemophilia, infection, trauma, and neurological conditions including diabetes are the biggest factors of secondary OA.[3,4]

The risk of knee OA is increased by obesity alone or in combination with metabolic variables. Menisci surgery increases the likelihood of getting OA in the knee by 2.6 times.[15,16] Osteoarthritis in the knee has been linked to partial meniscectomy and reconstruction surgery.[17] An almost two-fold increase in the risk of knee OA is seen in pregnancies greater than six times.[18] According to reports, women are more likely than males to develop knee OA.[19] Women who are approaching menopause appear to be at increased risk.[14]

Synovitis, which is directly responsible for several clinical symptoms and is the cause of the disease's structural progression, is the major component in the pathophysiology of osteoarthritis.[20] Pathology is made up of two things:

1. The progressive destruction of articular cartilage.
2. The formation of new bone at the margins of the joint (osteophytes).

Clinical symptoms of knee OA include pain while bearing weight, restricted joint motion, crepitus, sporadic effusion, and varying degrees of local inflammation. Pain and stiffness may cause a loss of functional independence if ignored or poorly handled.[21] As the condition worsens, patients gradually experience difficulty performing daily tasks like walking, squatting, climbing, and doing housework.[22] Patients with knee OA may experience poor balance and gait because of functional deficiencies that would limit their mobility and function. Pain, loss of movement, instability, deformity, and swelling are the primary symptoms of arthritis.[4,10]

The **Kellgren and Lawrence** system is a common method of classifying the severity of osteoarthritis (OA) using five grades. It is the most widely used clinical tool for the radiographic diagnosis of osteoarthritis and for helping medical professionals make better clinical decisions.

Grade 0: No joint space narrowing or reactive changes
Grade 1: Doubtful joint space narrowing (JSN) and possible osteophytes lipping
Grade 2: Definite osteophytes and possible JSN
Grade 3: Moderate osteophytes, definite JSN, some sclerosis, possible bone-end deformity
Grade 4: Large osteophytes, marked JSN, severe sclerosis and definite bone end deformity[23,13,24]

The center of foot pressure is the point of origin of the ground reaction force. GRF is the most important force during locomotor activities such as walking, skipping, hopping, jumping, and running. The GFRs may act on many points on the foot but the center of pressure (COP) is the point at which the forces are considered to act just as the COG of the body is designated as the point where the forces of gravity are considered to act.[25]

The foot pressure plate is the most accurate and cost-effective way to identify the plantar pressure profile and consists of thousands of sensors that record and analyze the gait in two-dimensional and three-dimensional graphical representations to detect anatomical imbalances and anomalies during activities like walking, running, lifting loads, and so on. Pressure plate analysis is a very simple and accurate procedure and shows a precise distribution of the body pressure on the feet, as well as the patient's center of gravity. It also provides a comparison of the pressure distribution between the two feet.[26]

Hypothesis

The Null Hypothesis:

There was statistically non-significant difference when comparing radiograph analysis, gait analysis that is deviation of foot COP, clinical scores, pain, and disability in various grades of knee OA.

The Research Hypothesis:

There was statistically significant difference when comparing radiographic analysis, gait analysis that is deviation of foot COP, clinical scores, pain, and disability in various grades of knee OA.

Objectives Of The Study

1 To quantify gait parameters in various grades of knee osteoarthritis.

a. To quantify the foot Center of Pressure deviation in grade 0 patients with normal radiographs
b. To quantify the foot Center of Pressure deviation in grade I Osteoarthritis patients.
c. To quantify the foot Center of Pressure deviation in grade II Osteoarthritis patients.
d. To quantify the foot Center of Pressure deviation in grade III Osteoarthritis patients.
e. To quantify the foot Center of Pressure deviation in grade IV Osteoarthritis patients.
2. To compare gait parameters that is foot Center of Pressure deviation, clinical scores, pain, and disability in normal subjects vs Osteoarthritis patients of all grades.

Purpose Of The Study

1. The purpose of the study is to quantitatively evaluate the changes in gait parameters in different grades of knee Osteoarthritis patients which is difficult to define by subjective clinical assessment. And to co-relate these changes with Clinical scores and symptoms such as Pain using Numeric Pain Rating Scale (NPRS) and Disability using Western Ontario and McMaster Universities Index Of Osteoarthritis (WOMAC)
2. To see whether the progression of the disease is associated with altered loading of the foot during gait.
3. To perform gait analysis using pressure measuring system as test for its clinical use.

METHODOLOGY

Study Design: Non-experimental and descriptive in nature.

Setting: The study was performed in OPD of D.A.V Institute of Physiotherapy and Rehabilitation, Jalandhar.

Duration of study: 3 years.

Sample Size: A minimum of 45 subjects were assigned to each group. A total of 295 subjects were purposefully assigned to five groups according to Kellgren & Lawrence Criteria.

Sampling Technique: Purposive sampling

Sample Selection

Inclusion criteria:

1. Subjects - 40-70 years of age.
2. Gender – Both male and female subjects
3. Unilateral or bilateral primary OA knee according to Kellgren and Lawrence criteria.
4. X-rays taken before three months were valid.

Exclusion criteria:

1. Subjects with a history of lower limb surgery or any fracture of the lower limb.
2. Subjects with congenital foot deformities.
3. Subjects who received intra-articular steroid injections and hyaluronans in the preceding 6 months.
4. Subjects who are unable to ambulate without assistance.
5. Subjects with any prior arthroplasty or arthroscopy in either knee.
6. Subjects with a history of any unstable medical conditions.
7. Subjects with a history of orthopedic problems such as rheumatoid arthritis, and soft tissue injuries such as tendinitis, bursitis, and apophysitis.
8. Subjects with a history of any neurological disease such as stroke, ataxia, Parkinsonism, tabes dorsalis.

Data Collection Procedure

Independent Variables:

- Grades of knee OA according to Kellgren and Lawrence.

Dependent Variables:

- Gait parameters:

(a) Centre of Pressure at heel, midfoot, forefoot, toe
(b) Stance time: pre-stance, mid-stance and terminal stance

- Clinical scores
- WOMAC (Western Ontario and McMaster Universities) Index of Osteoarthritis.
- NPRS (Numeric pain rating scale).

Method Of Collection Of Data

Protocol:

A written informed consent was obtained from the subjects at the beginning of study. Patients were radiographically graded according to the Kellgren and Lawrence scale and assigned to five groups : group A had patients of grade 0, group B had patients of grade 1, group C had patients of grade 2, group D had patients of grade 3, group E had patients of grade 4 knee OA. Each patient was assessed for disability and was asked to fill out the questionnaire (WOMAC) to get information about the type of disability at any present or past 48 hours that has affected the COP. Patients were further assessed for pain using NPRS, clinical scores using 30 30-point walking ability rating scale, and gait parameters using a pressure plate.

Procedure Of Collecting Gait Parameters:

Barefoot pressure measurement was carried out on the ORTHO-KING PRESSURE PLATE SDP 610. First, the height, weight, foot size, and age of all the subjects were recorded. Before taking the final readings, all the subjects were trained to stand and walk barefoot over the pressure plate. Before pressure measurements, subjects familiarized with the testing procedure and details of the procedure were explained.

Step I Static bipedal standing

The subjects were asked to look straight ahead while standing on the platform with both feet separated based on their normal style of standing and the plantar pressure distribution with bare feet was observed. The purpose here was to calculate the maximum pressure percentage and deviation of COP.

Step II Dynamic sampling

The subjects were asked to walk barefoot by keeping the left and right foot alternatively on the pressure plate and the COP was noted while walking.Here the curve shows the path of the COP

The measurement method for location of the COP:

The COP is quantified in the heel (H), midfoot (M), forefoot (F), and toe (T), Corrected by foot width (WW'), and quantified as the distance from the axis of the foot (AA'). COP outside the axis of the foot is expressed as (+) positive and COP inside the axis of the foot is expressed as (-) negative. In the following figure A represents the mid-posterior heel border and A' represents the mid-tip of the second toe, a represents the base of the second toe B represents the medial edge of the forefoot, B' represents the lateral edge of the fore foot, C represents midpoint Aa.

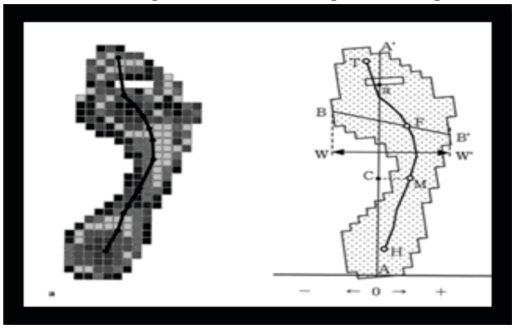


Figure showing quantification of COP trace.

Step III Multiple dynamic acquisition:
Same way the subject was asked to walk 3 times barefoot by keeping the left and right foot alternatively. This gives us an accurate mean reading of the parameters such as stance time (ms) which includes the phases (pre-stance, mid stance, terminal stance).[27,28]

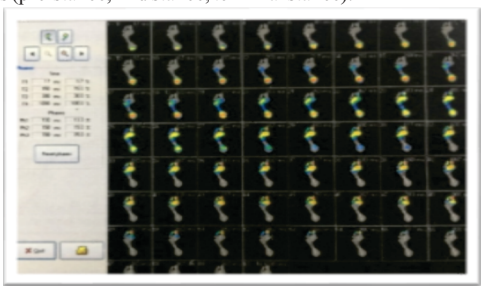


Figure showing total stance time (ms) and the Ph1, Ph2, Ph3 denotes the pre-stance, mid stance and terminal stance.

RESULTS:
Data was analyzed using SPSS software. A comparison between five groups was performed to study the significant difference between the two groups. Statistical tests were used for the analysis of data of osteoarthritis patients and normal subjects.

Table and Figure 1.1 Shows the frequency distribution of gender between all groups.

Descriptive Stat	Gender				
	Group A	Group B	Group C	Group D	Group E
Male %	22.0%	45.7%	33.0%	23.5%	37.5%
Female %	78.0%	54.3%	67.0%	76.5%	62.5%
Male	9	21	31	16	18
Female	32	25	63	52	30

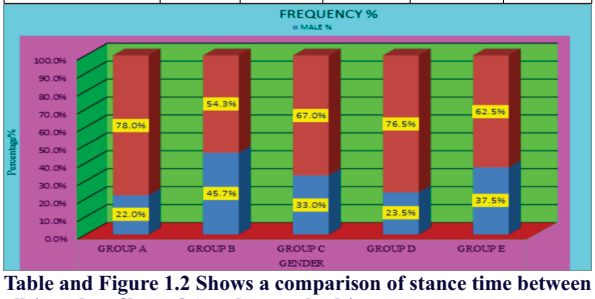
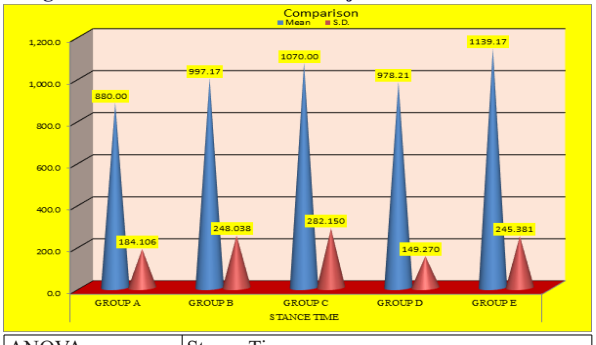


Table and Figure 1.2 Shows a comparison of stance time between all 4 grades of knee OA and normal subjects.



ANOVA	Stance Time				
	Group A	Group B	Group C	Group D	Group E
Mean	880.00	997.17	1070.00	978.21	1139.17
S.D.	184.106	248.038	282.150	149.270	245.381
Number	41	46	94	67	48
Maximum	1180	1940	2000	1290	2000
Minimum	160	700	620	630	720
Range	1020	1240	1380	660	1280
F test	8.555				
Table Value at 0.05	2.403				
P value	<0.001				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		Group A			
	Group B	117.17 NSIG	Group B		
	Group C	190 SIG	72.83 NSIG	Group C	
	Group D	98.21 NSIG	18.96 NSIG	91.79 NSIG	Group D
	Group E	259.17 SIG	141.99 SIG	69.17 NSIG	160.96 SIG

Table and Figure 1.3 Shows a comparison of % pre-stance time between all 4 grades of knee OA and normal subjects.

ANOVA	% Pre-Stance				
	Group A	Group B	Group C	Group D	Group E
Mean	18.46	6.89	11.03	3.61	2.65
S.D.	18.820	9.347	12.011	4.280	3.297
Number	41	46	94	68	48
Maximum	61.4	38.4	40.2	18.8	13.6
Minimum	1	0.7	0.7	0.6	0.5
Range	60.4	37.7	39.5	18.2	13.1
F test	17.695				
Table Value at 0.05	2.403				
P value	<0.001				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		Group A			
	Group B	11.57 SIG	Group B		
	Group C	7.44 SIG	4.14 NSIG	Group C	
	Group D	14.86 SIG	3.29 NSIG	7.43 SIG	Group D
	Group E	15.82 SIG	4.25 NSIG	8.39 SIG	0.96 NSIG

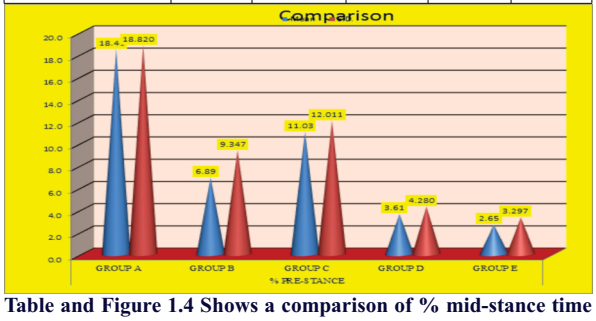


Table and Figure 1.4 Shows a comparison of % mid-stance time between all 4 grades of knee OA and normal subjects.

ANOVA	% Mid- Stance				
	Group A	Group B	Group C	Group D	Group E
Mean	31.94	27.10	27.66	19.99	20.49
S.D.	18.078	18.595	19.119	14.311	17.298
Number	41	44	94	68	48
Maximum	73.7	72.5	68.8	67.61	68.7
Minimum	8.7	2.8	0	0	0.4
Range	65	69.7	68.8	67.61	68.3
F test	4.445				
Table Value at 0.05	2.403				
P value	0.002				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		Group A			
	Group B	4.84 NSIG	Group B		
	Group C	4.29 NSIG	0.56 NSIG	Group C	
	Group D	11.95 SIG	7.11 NSIG	7.67 NSIG	Group D
	Group E	11.45 SIG	6.6 NSIG	7.17 NSIG	0.51 NSIG

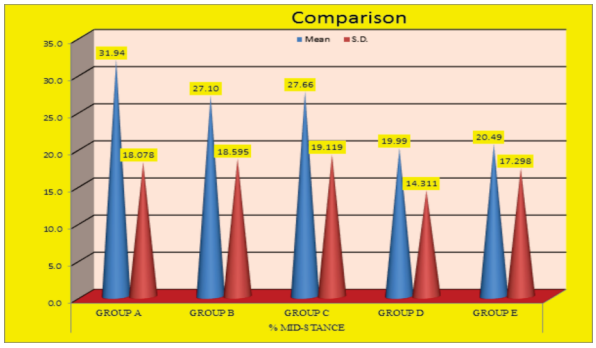


Table and Figure 1.5 Shows a comparison of terminal stance time between all 4 grades of knee OA and normal subjects.

ANOVA	%TERMINAL STANCE				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	46.06	64.45	60.51	74.82	78.05
S.D.	31.460	26.248	28.218	15.488	23.227
Number	41	44	94	68	48
Maximum	86.4	94	96	94.1	179.4
Minimum	0	9.3	8.8	32.39	29.6
Range	86.4	84.7	87.2	61.71	149.8
F test	12.299				
Table Value at 0.05	2.403				
P value	<0.001				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	18.39SIG	GROUP B		
	GROUP C	14.46SIG	3.93NSIG	GROUP C	
	GROUP D	28.76SIG	10.37NSIG	14.31SIG	GROUP D
	GROUP E	31.99SIG	13.6NSIG	17.54SIG	3.23NSIG

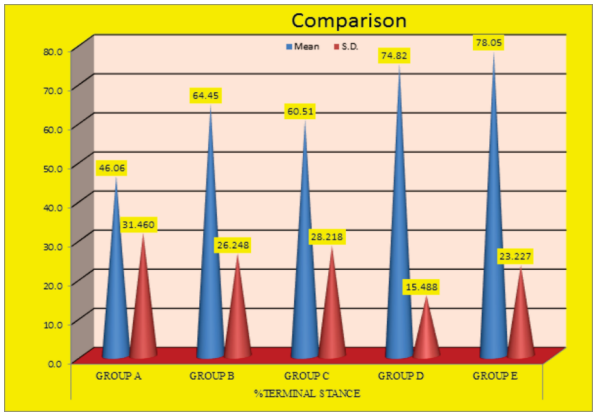


Table and Figure 1.6 Shows a comparison of AVF between all 4 grades of knee OA and normal subjects.

ANOVA	AVF				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	75.13	79.44	75.72	77.92	78.42
S.D.	10.865	13.463	16.541	11.704	14.062
Number	41	46	94	68	48
Maximum	110	110	119.6	101	105
Minimum	57.9	60	42	49.2	46.5
Range	52.1	50	77.6	51.8	58.5
F test	0.922				
Table Value at 0.05	2.403				
P value	0.451				
Result	Not Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	4.31NSIG	GROUP B		
	GROUP C	0.6NSIG	3.72NSIG	GROUP C	
	GROUP D	2.79NSIG	1.52NSIG	2.2NSIG	GROUP D
	GROUP E	3.29NSIG	1.02NSIG	2.7NSIG	0.5NSIG

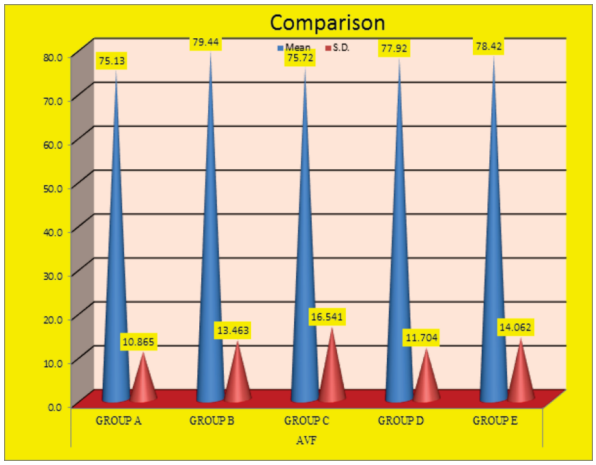


Table and Figure 1.7 Shows a comparison of COP deviation of heel strike between all 4 grades of knee OA and normal subjects.

ANOVA	HEEL				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	0.55	0.40	0.35	-0.37	-0.02
S.D.	1.055	1.636	1.514	1.525	2.051
Number	41	46	94	68	47
Maximum	5	5	7	4	10
Minimum	-1	-3	-3	-6	-3
Range	6	8	10	10	13
F test	3.296				
Table Value at 0.05	2.403				
P value	0.012				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	0.15NSIG	GROUP B		
	GROUP C	0.21NSIG	0.05NSIG	GROUP C	
	GROUP D	0.92SIG	0.77NSIG	0.72SIG	GROUP D
	GROUP E	0.57SIG	0.42NSIG	0.36NSIG	0.36NSIG

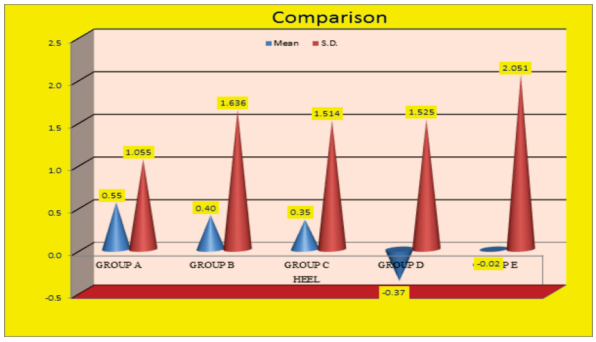


Table and Figure 1.8 Shows a comparison of COP deviation of midfoot between all 4 grades of knee OA and normal subjects.

ANOVA	MIDFOOT				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	2.88	1.11	1.35	1.57	1.01
S.D.	3.095	3.584	2.784	3.473	4.275
Number	41	46	94	68	48
Maximum	12	8	10	8	10
Minimum	-2	-7	-5	-7	-11
Range	14	15	15	15	21
F test	2.162				
Table Value at 0.05	2.403				
P value	0.073				
Result	Not Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	1.77NSIG	GROUP B		
	GROUP C	1.54NSIG	0.24NSIG	GROUP C	
	GROUP D	1.31NSIG	0.46NSIG	0.22NSIG	GROUP D
	GROUP E	1.87NSIG	0.1NSIG	0.34NSIG	0.56NSIG

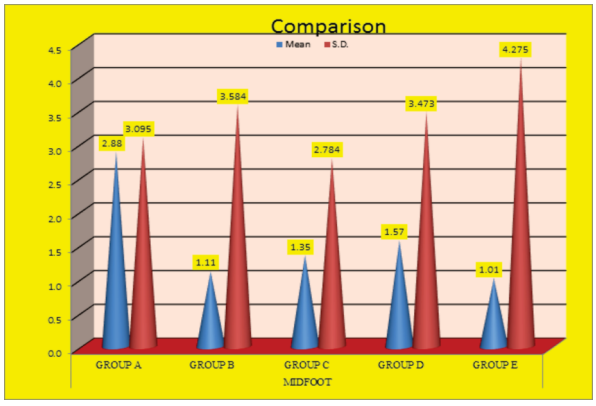


Table and Figure 1.9 Shows a comparison of COP deviation of forefoot between all 4 grades of knee OA and normal subjects.

ANOVA	FOREFOOT				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	3.36	1.77	1.30	0.99	1.01
S.D.	4.668	5.042	3.008	3.575	4.275
Number	41	46	94	68	48
Maximum	17	11	10	9	10
Minimum	-3	-10	-7	-7	-11
Range	20	21	17	16	21
F test	3.435				
Table Value at 0.05	2.403				
P value	0.009				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	1.59NSIG	GROUP B		
	GROUP C	2.07SIG	0.47NSIG	GROUP C	
	GROUP D	2.37SIG	0.78NSIG	0.31NSIG	GROUP D
	GROUP E	2.36NSIG	0.77NSIG	0.29NSIG	0.01NSIG

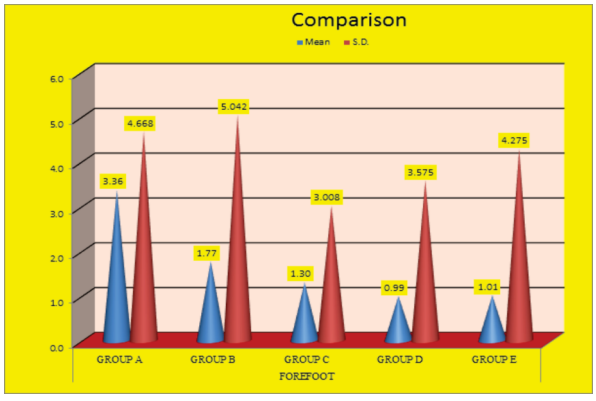


Table and Figure 1.10 Shows a comparison of COP deviation of toe-off between all 4 grades of knee OA and normal subjects.

ANOVA	TOE				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	1.60	1.77	-1.53	0.84	1.06
S.D.	6.453	5.042	5.478	6.595	6.487
Number	41	46	94	67	48
Maximum	13	11	13	11	13
Minimum	-11	-10	-13	-12	-13
Range	24	21	26	23	26
F test	3.675				
Table Value at 0.05	2.403				
P value	0.006				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	0.17NSIG	GROUP B		
	GROUP C	3.13SIG	3.3SIG	GROUP C	
	GROUP D	0.76NSIG	0.93NSIG	2.37NSIG	GROUP D
	GROUP E	0.54NSIG	0.71NSIG	2.59NSIG	0.22NSIG

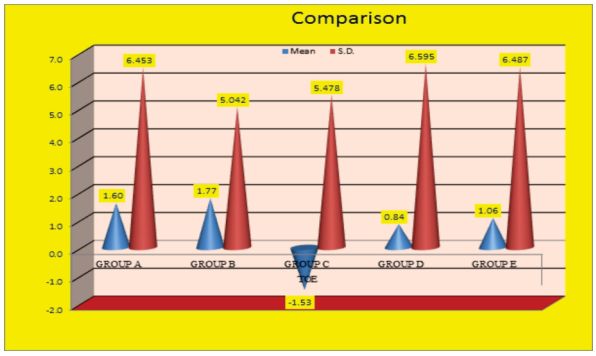


Table and Figure 1.11 Shows a comparison of clinical scores of all 4 grades of knee OA and normal subjects.

ANOVA	CLINICAL SCORES				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	30.00	27.83	23.83	19.56	17.92
S.D.	<0.001	4.170	5.931	5.236	6.906
Number	41	46	94	68	48
Maximum	30	30	30	30	30
Minimum	30	10	10	10	10
Range	0	20	20	20	20
F test	46.235				
Table Value at 0.05	2.403				
P value	<0.001				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	2.17NSIG	GROUP B		
	GROUP C	6.18SIG	4SIG	GROUP C	
	GROUP D	10.44SIG	8.27SIG	4.27SIG	GROUP D
	GROUP E	12.08SIG	9.91SIG	5.91SIG	1.64NSIG

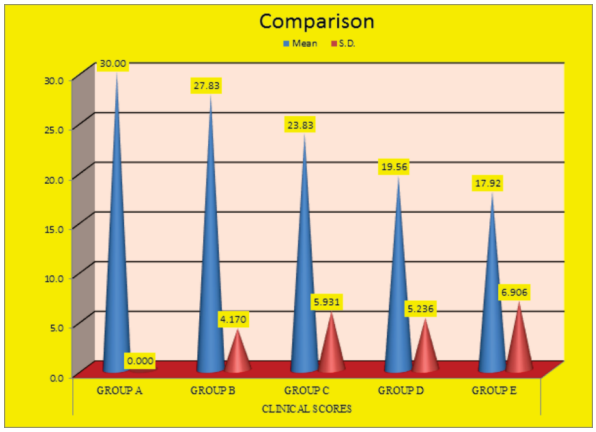


Table and Figure 1.12 Shows a comparison of WOMAC scores between all 4 grades of knee OA and normal subjects.

ANOVA	WOMAC				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	3.54	17.26	30.87	46.74	55.92
S.D.	4.359	12.279	16.422	15.690	17.935
Number	41	46	94	68	48
Maximum	16	50	77	80	82
Minimum	0	2	0	0	14
Range	16	48	77	80	68
F test	97.070				
Table Value at 0.05	2.403				
P value	<0.001				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	13.72SIG	GROUP B		
	GROUP C	27.34SIG	13.61SIG	GROUP C	
	GROUP D	43.2SIG	29.47SIG	15.86SIG	GROUP D
	GROUP E	52.38SIG	38.66SIG	25.04SIG	9.18SIG

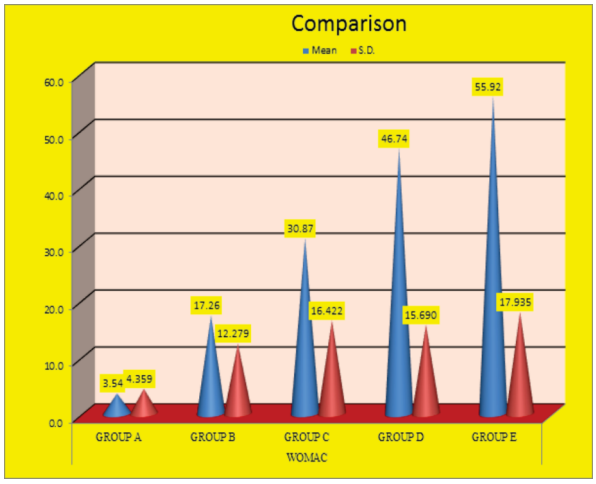
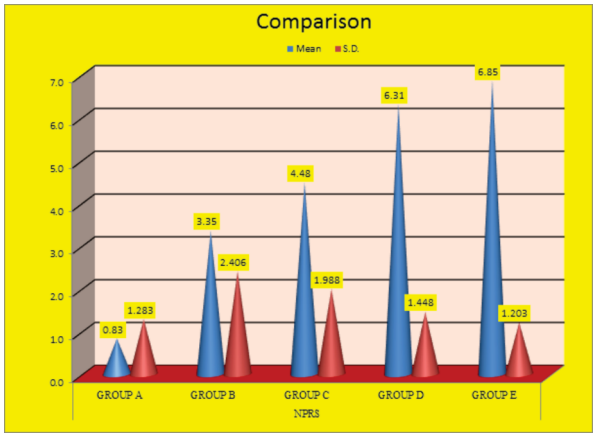


Table and Figure 1.13 Shows a comparison of NPRS scores between all 4 grades of knee OA and normal subjects.

ANOVA	NPRS				
	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
Mean	0.83	3.35	4.48	6.31	6.85
S.D.	1.283	2.406	1.988	1.448	1.203
Number	41	46	94	68	48
Maximum	6	9	9	8	9
Minimum	0	0	0	0	4
Range	6	9	9	8	5
F test	88.919				
Table Value at 0.05	2.403				
P value	<0.001				
Result	Significant				
Tukey's method for Pairwise comparison					
Result with mean difference of Pair>		GROUP A			
	GROUP B	2.52SIG	GROUP B		
	GROUP C	3.65SIG	1.13SIG	GROUP C	
	GROUP D	5.48SIG	2.96SIG	1.83SIG	GROUP D
	GROUP E	6.02SIG	3.51SIG	2.38SIG	0.55SIG



CONCLUSION

The study concluded that gait parameters that is foot Center of Pressure deviation, clinical scores, pain, and disability showed statistically significant differences between normal subjects vs Osteoarthritis patients of all grades. It also concluded that average vertical force and COP deviation at mid-foot showed statistically non-significant differences between normal subjects vs Osteoarthritis patients of all grades.

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