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Effect of Physiotherapy Treatment on Gait Variables in Osteoarthritis Knee Patients

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Abstract: ***Background: Osteoarthritis (OA) of knee joint is the most common disorder leading to functional disabilities especially during walking. Studies have shown that pain and muscle weakness associated with OA causes alteration in gait. Hence, present study is done to investigate the effect of physiotherapy treatment on gait variables in OA knee patients. Objectives: To study the effect of physiotherapy treatment on pain, physical function and gait variables (step length, stride length and cadence) in OA knee patients. Method: 20 subjects between age group of 45-60 years having grade 1, 2 ,3 OA on Kellgren and Lawrence scale with bilateral knee involvement, having pain intensity more than 3 on Visual Analogue Scale (VAS) were taken for the study. Pain on VAS, physical function on WOMAC index and gait parameters were recorded on first day. Patients were then given intervention for 3 weeks on alternate days which included burst TENS for 20 mins, strengthening and proprioceptive training. All outcome measures were recorded again on last day. Results: Study showed statistically significant improvement in pain, physical function, an increase in step length, stride length and cadence following physiotherapy treatment. Conclusion: Study showed improvement in gait variables following physiotherapy treatment in OA knee patients.***

Keywords: Osteoarthritis, knee pain, gait variables, physiotherapy treatment

1. Introduction

Osteoarthritis is a degenerative joint disease clinically characterized by pain, joint stiffness and muscle weakness. Osteoarthritis of knee joint is one of the most common disorder greatly contributing to functional disabilities especially during walking, squatting, staircase climbing, etc. [1]

Wear and tear of articulate cartilage and hence affection of underlying bone followed by reduced proprioception has been proposed to be responsible for initiation and advancement of degeneration of knee joint.[1] Structural changes in joint ligaments and disruption of joint mechanoreceptors cause reduction in joint proprioception. This alters muscular ability to provide dynamic stabilization to the joint by co-contraction and hence alters gait. [2]

The diagnosis of osteoarthritis is mainly based on following radiological features: [1]

- Narrowing of joint spaces, often limited to a part of the joint.
- Subchondral sclerosis: dense bone under the articular surface.
- Osteophyte formation.
- Loose bodies.
- Deformity of the joint.

The Kellgren and Lawrence grading system is used to grade osteoarthritis of knee joint. Its grading is as follows: [1]
Normal - No wears.
Grade l - Unlikely narrowing of the joint space, possible osteophytes.
Grade 2 - Identified small osteophytes, possible narrowing of the joint.
Grade 3 - Multiple moderately sized osteophytes, definite joint space narrowing and some sclerotic areas.
Grade 4 - Multiple large osteophytes, severe joint space narrowing, marked sclerosis and definite bony end deformity.

Gait is described as a translatory progression of the body as a whole, produced by coordinated, rotatory movements of the body segments. [2] Gait cycle is divided into 2 phases: stance phase which makes up to 60% of gait cycle and swing phase which makes up to 40% of gait cycle. [2] Time and distance variables are two basic components of motion and measurement of these variables provide basic description of gait as well as quantitative information about a person's gait. [2] The temporal variables include cadence, speed, step time and stride time, single limb and double limb support time and swing time. The distance variables include stride length, step length, width of base of support and degree of toe out. [2]

Pain and muscle weakness is the prime cause of altered gait variables. [3] Studies have shown that there is decreased walking speed, decreased step & stride length and decreased cadence in patients of OA knee. [4] Hence the following study is done to determine the effect of physiotherapy treatment on these gait variables.

2. Review of Literature

Syed A. Haq, Fereydoun Davatchi (2011) investigated the data on osteoarthritis knee in Community Oriented Program for Control of Rheumatic Disorders (COPCORD) publications by doing a literature search through PubMed, Google, Proceedings of Asia-Pacific League of Associations for Rheumatology (APLAR) congresses, and Abstracts from APLAR congresses. Study concluded that OA knee is the commonest rheumatic disease found in the community. It was found to be more common among women. Overweight, squatting and cycling were found to be the modifiable risk factors for OA knee. [5]

B Hassan, S Mockett, and M Doherty (2001) in their study, compared static postural sway, proprioception, and maximal voluntary quadriceps contraction in patients with knee osteoarthritis and normal control subjects. They concluded that as compared to normal controls, subjects with symptomatic OA knee exhibit quadriceps weakness, reduced knee proprioception, and increased postural sway. Pain and muscle strength was found to influence postural sway. [6]

Fransen M, Crosbie J, Edmonds J (1997) examined the intrasession and intersession reliability of measurements of quantitative gait variables at two self-selected walking speeds in 41 patients with OA knee. Quantitative gait variables like walking speed, cadence, and stride length were found to be practical objective assessment tools for patients with OA knee. Also, gait at the fast walking speed was found to provide the more reliable measure to assess the effectiveness of therapy when compared with gait at the normal walking speed. [4]

Fırat Altay, Dilek Durmuş, Ferhan Canturk (2010) studied the effect of TENS on Pain, Disability, Quality of Life and Depression in Patients with knee osteoarthritis. Results of this study suggest that addition of TENS to exercise program is more effective in decreasing knee pain and related disability and improving quality of life in patients with OA knee. [7]

Cheing GL, et al. (2003) examined the optimal stimulation duration of TENS for relieving osteoarthritic knee pain. A significantly greater reduction in pain measured on visual analogue scale was found when TENS was given for 20 minutes. [8]

Pearl P. W. Law, Gladys L. Y. Cheing (2004) studied optimal stimulation frequency of TENS on people with knee osteoarthritis. The study demonstrated that 2 weeks of repeated applications of transcutaneous electrical nerve stimulation at low frequency (2 Hz), high frequency (80-100 Hz) or alternating low and high frequencies (2/100 Hz) produced similar treatment effects for people suffering from OA knee. [9]

Mikesky Alan, MazzucaSteven, et al. (2006) studied the effects of strength training on the incidence and progression of knee osteoarthritis. The study randomized 221 older adults with OA knee to either strength training group or range of motion exercises group. Both group exercised 3 times per week for 12 weeks. Assessment of isokinetic lower extremity strength was done at baseline and at 30 months. It was observed that strength training group retained more strength and exhibited less progression of joint space narrowing than ROM group. [10]

3. Methodology

20 patients with osteoarthritis knee referred to physiotherapy department and willing to take treatment for 3 weeks were recruited for the study. A verbal consent was taken from them. Inclusion criteria were: 1] Patients between age group of 45-60 years, both males and females, 2] Patients with bilateral knee involvement, 3] Patients with patellofemoral as well as tibiofemoral joint affection, 4] Patients having a VAS score of more than 3, 5] Grade 1, 2 and 3 OA knee on Kellgren and Lawrence scale. Exclusion criteria were: 1] Secondary OA knee, 2] Rheumatoid arthritis, 3] Patients with any other knee joint disease like septic arthritis, etc., 4] Fractures of lower extremity in past 3 months, 5] Any knee surgeries done in past 6 months.

Outcome measures:
1) Visual Analogue Scale
2) WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) Score
3) Gait Variables: Step Length, Stride Length, Cadence

General assessment including history of onset, duration and progression, severity of pain on visual analogue scale, grades of osteoarthritis of knee on Kellgren and Lawrence scale and physical function on WOMAC index were recorded. Also gait parameters like step length, stride length and cadence were measured on first day. Following this patient was given treatment for 3 weeks on alternate days i.e. 9 sessions which included Burst TENS for 20 mins, strength training and proprioceptive training. On last day patient was re-evaluated and the above parameters were recorded again.

Procedure of recording outcome measures:
- Visual analogue scale - patient was asked to mark the intensity of his or her pain on a 10cm scale where 0 is no pain and 10 is maximum pain.
- WOMAC index - is used to assess physical function in patients with knee osteoarthritis. It measures 17 parameters of physical function. Higher the score more is the functional disability.
- Gait variables - patients were asked to stand in a tub filled with water, so that their feet get wet. Then they were asked to walk on a wooden floor. Their footprints were outlined using chalk. Then the following gait variables were measured (Figure 1, 2, 3).

Step length – is determined by measuring the linear distance between two successive heel strikes.
Stride length - is determined by measuring the linear distance from point of heel strike of one lower extremity to the point of the next heel strike of the same extremity.

Cadence - it is measured as the number of steps per minute.

4. Materials used

- For measuring gait parameters: plastic tub, water, wooden floor, chalks, measuring tape, stop watch.
- For intervention: TENS machine, 2 double channel electrodes, straps, conducting gel, weight cuffs, and stability trainers.

Intervention:
1) Burst TENS for 20 mins. Patients were made to lie supine on the plinth. Electrodes were placed on medial-lateral aspect of knee joint.
2) Strength training: 1st wk – isometric exercises for quadriceps, hamstrings, glutei, hip abductors, adductors, dorsiflexors, plantarfexors.

2nd wk - 10 RM of hip flexors, extensors, abductors, knee flexors, extensors, dorsiflexors and plantarflexors was found. 1 set of 10 repetitions was performed.
3rd wk – 2 sets of 10 repetitions each were performed.

3) Proprioceptive training: Stability trainers were used for training proprioception. The stability trainer on which the subject was able to balance himself in stance position for 1 minute was used for the intervention. Subjects were asked to perform following:
   - Stance with eyes open/ eyes closed
   - Stride standing with eyes open/ eyes closed
   - Tandem standing with eyes open/ eyes closed
   - Pertubations in stance position.

The above positions were maintained for 30seconds each.

Figure 1, 2, and 3: Measurement of gait variables

Figure 1

Figure 2

Figure 3

5. Results

Data was analysed using GraphPad InStat software version 3.0 and Microsoft Excel. Normality of data was assessed using One-Sample Kolmogorov-Smirnov Test. Paired t-test was used for the data passing normality whereas Wilcoxon Signed Ranks test was used for the data not passing normality test.

Study was conducted on 20 patients with bilateral OA knee between age group of 45-60 years (51.1± 4.88). 75% of patients in the study were females while 25% were males. As evident from table no.1 and 2, it was observed that the pain in both, more as well as less symptomatic knee joint was significantly reduced following 3 weeks of physiotherapy treatment. Also, as evident from table no.3, physical function was found to be significantly improved. Step length and stride length of both, more as well as less symptomatic knee joint was markedly increased (table no. 4,5,6,7). A significant increase in cadence was also observed (table no.8).

Table 1: Effect of physiotherapy treatment on pain (of more symptomatic knee)

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	7.5	1.469	-	< 0.0001
Post	20	2.35	1.137		

Table 2: Effect of physiotherapy treatment on pain (of less symptomatic knee)

	N	*Mean*	*SD*	*T-value*	*P-value*
Pre	20	4.7	0.9787	-	< 0.0001
Post	20	0.45	0.7592		

Table 3: Effect of physiotherapy treatment on physical function

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	35.85	6.869	-	< 0.0001
Post	20	24.2	5.578		

Table 4: Effect of physiotherapy treatment on step length (of more symptomatic knee)

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	17.725	2.251	8.059	< 0.0001
Post	20	18.775	2.185		

Table 5: Effect of physiotherapy treatment on step length (of less symptomatic knee)

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	18.175	2.530	6.493	< 0.0001
Post	20	19.075	2.478		

Table 6: Effect of physiotherapy treatment on stride length (of more symptomatic knee)

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	34.4	4.154	4.616	0.0002
Post	20	35.225	4.200		

Table 7: Effect of physiotherapy treatment on stride length (of less symptomatic knee)

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	35.525	4.182	2.203	0.0401
Post	20	35.95	3.866		

Table 8: Effect of physiotherapy treatment on cadence

	N	*Mean*	*SD*	*t-value*	*p-value*
Pre	20	94.7	6.408	14.123	< 0.0001
Post	20	103.4	6.524		

6. Discussion

TENS is the application of pulsed rectangular wave current via surface electrodes. Burst TENS is a series of impulse 1-5 times/second at high frequency of 40-l50Hz and high intensity. [11] The low threshold A beta fibres gives off collaterals which impinge on nociceptive A delta & C pain fibres in posterior horn. The electrical impulses stimulate these A beta mechanoceptors & reduces the excitability of nociceptor cells to pain stimuli. [7] Thus it effectively reduces pain perception. Electrical impulses also stimulate A delta fibres which through its connection via interneurons damp C-fibre system. In this way, pain from nociceptors in the articular cartilage and due to tissue damage is reduced significantly. [7] Findings of the present study are consistent with the study done by Fırat Altay et al. (2010) which suggested that addition of TENS to exercise program is more effective in decreasing knee pain and related disability in patients with OA knee. [7]

Disuse atrophy occurs due to pain, guarding or postural habit. [3] Quadriceps: hamstrings ratio is altered, there may be physiological extensor lag due to quadriceps weakness. In addition, weakness of hip abductors in osteoarthritic patients leads to increased lateral pelvic tilts during gait cycle. Due to these changes in musculature, strength training becomes an integral part of rehabilitation of osteoarthritic knee joint. [3] Strength training restores muscle balance and allows the joint to function as close to the kinesiological standard as possible. It decreases energy required by the articular structures, thus reducing the load on the joint and contributes to a healthier joint alignment. This also slows disease progression and helps reduces symptoms and improves physical functioning. [3]

Strength training helps in achieving static stability, but for smooth and coordinated activities of daily living, an excellent dynamic stability is required. Proprioceptive training helps in restoring this dynamic joint stability. [3]
Human body has inherent ability to recognize and react to movements that it identifies as familiar or patterned, which may be stored in muscle memory. [6] Proprioceptive exercises use similar movement pattern and allow body to react appropriately. By implementing appropriate purpose, posture, positioning we can efficiently effect patients state of functioning. Reasons for these changes are attributed to neuromuscular adaptation which involves changes in ability of nervous system to recruit appropriate muscles to obtain a desired result. [6]

Proprioceptive exercises cause an increase in afferent supply, which acts as a stimulus to neuron carrying proprioceptive feedback from the joint, thus improving proprioception via improved motor unit recruitment and improved activation of type 2 fibres. [6]

Thus the study shows that the combined effect of TENS, strength training and proprioceptive training improves the gait variables and physical function in osteoarthritis knee patients.

7. Conclusion

The study concluded that there is significant improvement in pain, physical function and gait variables like step length, stride length and cadence following physiotherapy treatment for 3 weeks in patients suffering from osteoarthritis of knee joint.

8. Future Scope

Further research should be conducted over a larger sample size in a gait laboratory using video cameras for evaluation of minute gait alterations and computerized equipment's to rule out manual error. Effect of physiotherapy treatment on temporal variables like stance time, single limb and double limb support time, swing time, stride and step time can also be studied.

References

[1] J. Maheshwari: Essential ORTHOPAEDICS (3rd edition revised) - chp - 35, page no.-252-253.
[2] Cynthia C. Norkins, Pamela Levangie: Joint Structure & Function (4th edition) – chp - 11, page no. - 418-421.
[3] Carolyn Kisner, Lynn Allen Colby: Therapeutic Exercise (5th edition) – chp - 21, page no. - 693 -695.
[4] Fransen M, Crosbie J, Edmonds J: Reliability of gait measurements in people with osteoarthritis of the knee, Physical Therapy, Volume 77, Issue 9, pages 944-953, September 1997.
[5] Syed A. Haq, Fereydoun Davatchi: Osteoarthritis of knee in COPCORD world, International Journal of Rheumatic Diseases, Volume 14, Issue 2, pages 122-129, May 2011.
[6] B Hassan, S Mockett, and M Doherty: Static postural sway, proprioception, and maximal voluntary quadriceps contraction in patients with knee osteoarthritis and normal control subjects, Annals of rheumatic disease, Volume 60, Issue 6, pages 612–618, June 2001.
[7] Fırat Altay, DilekDurmuş, FerhanCanturk: Effects of TENS on Pain, Disability, Quality of Life and Depression in Patients with Knee Osteoarthritis, Turkish journal of rheumatology, Volume 25, Issue 3, pages 116-121, 2010.
[8] Cheing GL, Tsui AY, Lo SK, Hui-Chan CW: Optimal stimulation duration of TENS in the management of osteoarthritic knee pain, Journal of rehabilitation medicine, Volume 35, Issue 2, pages 62-68, March 2003.
[9] Pearl P. W. Law and Gladys L. Y. Cheing: Optimal stimulation frequency of TENS on people with knee osteoarthritis, Journal of rehabilitation medicine, Volume 36, Issue 5, pages 220-225, September 2004.
[10] Mikesky Alan, MazzucaSteven, et al.: Effects of strength training on the incidence and progression of knee osteoarthritis, Journal of arthritis and rheumatism, Volume 55, Issue 5, pages 690-699, October 2006.

[11] Angela Forster, Nigel Palastanga: Clayton's Electrotherapy and practice\ (9th edition): chp - 3, page no. - 103-105.
[12] Low and Reed: Electrotherapy Explained - chp- 3, page no. - 90-95.

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