Original Article

EFFECTIVENESS OF KINESIO TAPING AND COMBINED CHAIN EXERCISES IN INDIVIDUALS WITH KNEE OSTEOARTHRITIS: A CASE SERIES

Musa Sani Danazumi[1,2], Bashir Bello[1], Shehu Usman Ibrahim[1], Abdulsalam Mohammed Yakasai.[3,4]
[1]Department of Physiotherapy, Faculty of Allied Health Sciences, College of Health Sciences,
Bayero University, Kano, Nigeria.
[2]Federal Medical Centre Nguru, Yobe State, Nigeria.
[3]Medical Rehabilitation Therapists Board (Reg.), North-West Zonal Office, Kano, Nigeria.
[4]Department of Physiotherapy, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa.

ABSTRACT

Background: Combined Chain Exercises (CCEs) and Kinesio Taping (KT) are reported individually to improve pain and physical limitations in individuals with knee osteoarthritis (OA).
Objectives: This study determined the effectiveness of a 6 weeks program of Kinesio Taping (KT) and Combined Chain Exercises (CCEs) in the management of individuals with chronic knee OA.
Method: The study was a 5 case series of individuals with moderate to severe chronic knee OA with a mean age of 44.58 years and mean BMI of 27.62 kg/m^2. Each participant received a 6 weeks program of KT and CCEs. Pre-test and Post-test scores of pain intensity (PI), knee range of motion (ROM), muscle strength and general perception of recovery were assessed using Visual Analogue Scale (VAS), Goniometry, Western Ontario and McMaster University Index (WOMAC), Oxford's Muscle Grading (OMG) System and Global Rating of Care (GROC) respectively.
Result: Pre-test and post-test analysis using paired t-test, revealed that all the participants had significant improvement in the variables measured after 6 weeks of intervention as compared with their baseline values ($p<0.05$), except for quadriceps muscle strength and knee flexion ROM which showed that these data were not significantly different from the baseline ($p>0.05$).
Conclusion: The findings of this study concluded that a six (6) weeks program of Kinesio Taping (KT) and Combined Chain Exercises (CCEs) is effective for the improvement in **pain, functional limitation, extension range of motion (ROM) and general perception of recovery** in individuals with knee osteoarthritis.It was recommended that a larger study, after obtaining appropriate ethical approval, may be done to determine the efficacy of this form of treatment.
Keywords: Kinesio Taping; Combined Chain Exercises; Osteoarthritis; Case Series

NigerJmed 2020: 43-48

INTRODUCTION

Osteoarthritis (OA) is a form of progressive arthritis caused by the usual end-stage presentation of abnormal joint loading and subsequent articular cartilage disintegration.[1]It is associated with an extremely high economic burden, which is largely attributable to the effects of disability, co-morbid diseases and the expense of treatment.[2] Knee OA is a disease with a high incidence and prevalence, with the number of affected individuals expected to increase, particularly due to the ageing of the population, obesity and a sedentary lifestyle.

Knee OA has been managed using many therapeutic modalities including exercise therapy, which has been shown to affect the articular cartilage metabolism and also modifies the cartilaginous structure by a mechano-transduction response.[3] However, not all forms of exercises are effective in the management of knee OA and a previous study indicated that Combined Chain Exercises (CCEs) have been proven to improve pain and physical limitations in patients with knee OA. In spite of this, a systematic review and meta-regression analysis of the literature revealed that exercise therapy alone is not clinically beneficial in terms of changes in pain and function in individuals with knee OA, which suggest that other adjunct therapies are essentially needed.

Kinesio taping (KT) as a modality, is increasingly being considered for the management of individuals with knee OA. Although there is still limited data on the application of Kinesio tape in the management of knee OA, it has been shown that KT of the knee can reduce knee pain, improve the active range of motion and improve proprioception in patients with knee OA by improving patello-femoral alignment and lowering mechanical stress on soft tissues.[4]

However, not all OA patients may respond to specific treatment equally due to selective target of the therapy. In addition, even though studies tend to show positive effects with the use of exercises or KT in isolation, there is tendency for patients to make a faster recovery with increased treatment satisfaction and functional benefits if different therapies are combined. Moreover, due

Correspondence to :
Musa Sani Danazumi,
Department of Physiotherapy,
Faculty of Allied Health Sciences, College of Health Sciences,
Bayero University Kano,Nigeria.
Email: musadanazumisani@gmail.com
Tel: +234-8145123496.

to the heightened concern that both the articular cartilage metabolism and myofascial restriction in the knee can share independent mechanisms, techniques that are believed to challenge both the two problems are therefore highly warranted. Furthermore, scarcity of literature examining the effects of KT and CCEs in patients with knee OA suggests that more studies are needed to establish the efficacy of these treatments. For this reason, this study examined for the first time, the effectiveness of a 6 weeks program of combined KT and CCEs on pain, functional limitation, knee joint range of motion, muscle strength and perception of recovery in individuals with knee OA.

2. MATERIALS AND METHODS

Participants

Five patients with clinical and radiographic evidence of knee OAwere studied between January–June 2019. The pre-treatment examinations included a complete medical history, physical examination with particular attention to the vital symptom of OA represented by the pain threshold and X-ray. We excluded those with an allergic reaction to tape or any skin problems (on the basis of a history of allergies (specific or general) and/or pre-application test), the presence of any inflammatory arthritis, history of any injection at the knee, surgical intervention at the knee and suspicion regarding other pathologies in the knee. The most common symptoms presented before the treatment were: pain, stiffness and crepitation. Informed consent was obtained from each participant, and the study was conducted in the Physiotherapy Department of Federal Medical Centre (FMC), Nguru, Yobe State, Nigeria.

Study Protocol

This study examined a case series of 5 patients diagnosed with knee OA. The interventions were administered for 6 weeks period, and each participant received a combination of Kinesio taping and Combined Chain Exercise (CCEs) (see Table 2 for treatment summary). A total of 12 sessions was administered, and each participant had 2 sessions per week for 6 weeks. Furthermore, participants were required not to alter their normal activities of daily living or take part in any additional form of physical or medical therapies without the consent of the researchers. This was also monitored while the study was ongoing. Paired t-test was used to compare the outcomes at baseline and after 6 weeks of intervention.

Kinesio Tape (KT) Application

The KT was applied using the Castrogiovanni et al. protocol. This involved the use of 3 Kinesio tape strips: 2 'Y-strips' with a length of approximately 20 cm, an anchor of 2 cm and a single longitudinal section (1 'I-strip'). See figure 1a. The KT was applied with tension to give a stabilizing effect.

Tails of the quadriceps strip were applied to the patella, wrapping the patella medially and laterally with 25% tension. The base of the strip was applied with paper-off tension towards the anterior superior iliac spine. For the second strip, a Y-strip was applied with the knee flexed to 90 degrees between tibial tuberosity and inferior pole of the patella. The tails of the second strip were applied wrapping patella medially and laterally with 25% tension. The tails were directed towards vastus medialis and vastus lateralis. For the third strip, an I-strip was applied with the knee flexed to 30 degrees. The strip was applied to patella mediolaterally with 75% tension in the middle and paper-off tension at the ends (see figures: 1A, 1B &1C).The tapes were replaced during each treatment session and were retained throughout the week. In cases of rare separation of the tape, the participants were asked to come back immediately for re-application.

Combined Chain Exercises (CCEs)

The CCE was administered using the protocol of Olagbegi et al. This involved a combination of the open and closed kinematic chain exercises in the following pattern:

(i) Open kinetic chain exercises: Straight leg raising (SLR) and Full-arc extension.

(ii) Closed kinetic chain exercises: Quadriceps setting and Wall slides.

Table 1: Demographic Characteristics

S/N	Age	Sex	BMI	Duration	Occupation
1	45yrs	M	27.2kg/m^2	2yrs	C/ S
2	42yrs	F	26.67kg/m^2	1yr	C/S
3	36yrs	M	25.45kg/m^2	6mth	Trader
4	33yrs	M	28.37kg/m^2	8mth	Trader
5	54yrs	F	32.67kg/m^2	2yrs	C/S

S/N= Serial Number, BMI= Body mass index, C/S= Civil servant, yrs= years, F= Female, M= Male.

Outcome measures

For all participants, functional limitations were assessed using Western Ontario and McMaster Universities Arthritis Index (WOMAC). Pain intensity was also assessed using Visual Analogue Scale for Pain (VAS; 0-100 mm) and knee joint range of motion was assessed using goniometry while quadriceps muscle strength was assessed using Oxford's muscle grading system. Global Rating of Care Scale (GROC) was used to assess individuals' perception of change care.

Figure 1A: Kinesio Taping Application (Anterior View)

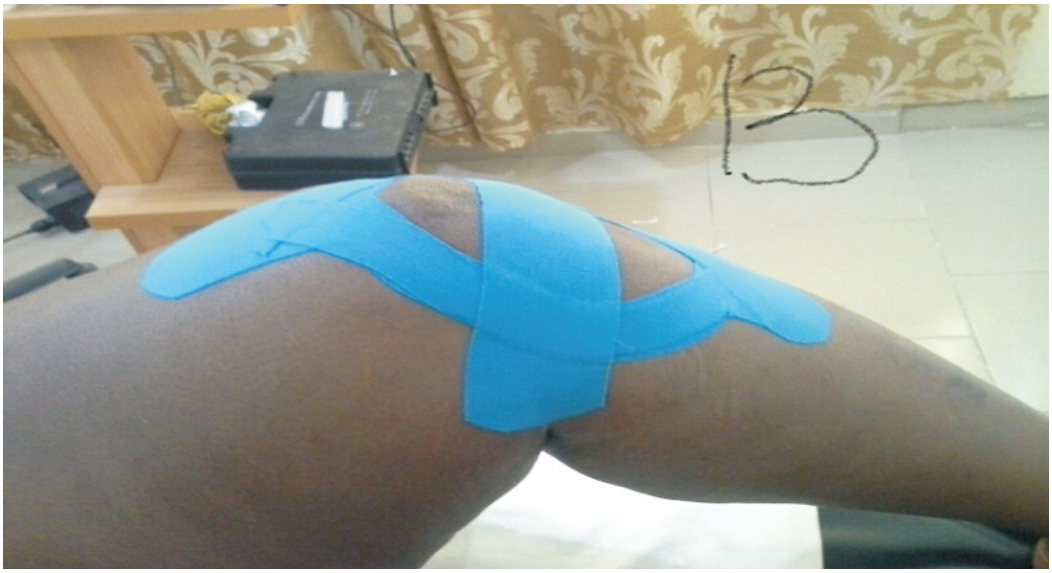

Figure 1B: Kinesio Taping Application (Medial View)

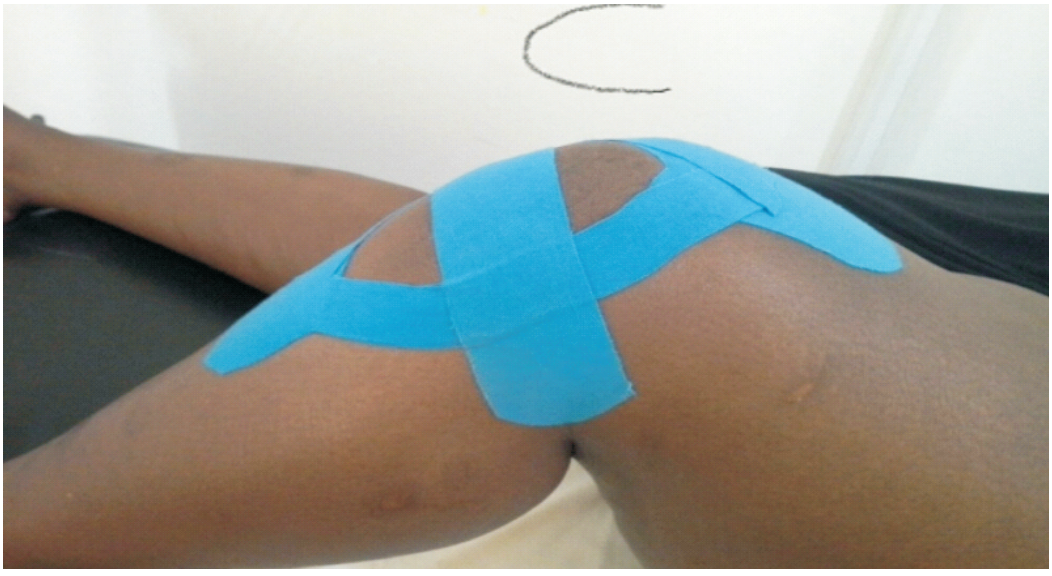

Figure 1C: Kinesio Taping Application (Lateral View)

Table 2: Treatment Procedure Summary

Weeks	KT &CCEs
Week 1	(a) Quadriceps setting (10 repetitions) (b) Straight leg raising (10 repetitions) (c) Squatting exercises (10 repetitions) (d) Cycling in the air (2 min for a bout) (e) Kinesio Taping
Week 2	(a) Quadriceps setting (10 repetitions) (b) Straight leg raising (10 repetitions) (c) Squatting exercises (10 repetitions) (d) Cycling in the air (2 min for a bout) (e) Wall slides without weight (10 repetitions) (f) Step-up and down without weight (10 reps) (g) Kinesio Taping
Week 3	(a) Quadriceps setting (10 repetitions) (b) Straight leg raising with weight (10 reps) (c) Squatting exercises (10 repetitions) (d) Cycling in the air (2 min for a bout) (e) Wall slides with weight (5kg) (f) Step-up and down with weight (5kg) (g) Full-arc extension (3 bouts of 10 reps) (h) Kinesio Taping
Week 4	(a) Quadriceps setting (10 repetitions) (b) Straight leg raising with weight (10 reps) (c) Squatting exercises (10 repetitions) (d) Cycling in the air (2 min for a bout) (e) Wall slides with weight (5kg) (f) Step-up and down with weight (5kg) (g) Full-arc extension (3 bouts of 10 reps) (h) Kinesio Taping
Week 5	(a) Quadriceps setting (10 reps) (b) Straight Leg Raising with weight (10 reps) (c) Squatting exercises (10 reps) (d) Cycling in the air (2 min for a bout) (e) Wall slides with eight (5kg) (f) Step-up and down with weight (5kg) (g) Full-arc extension (3 bouts of 10 reps) (h) Kinesio Taping
Week 6	(a) Quadriceps setting (10 reps) (b) Straight leg raising with weight (10 reps) (c) Squatting exercises (10 reps) (d) Cycling in the air (2 min for a bout) (e) Wall slides with weight (5kg) (f) Step-up and down with weight (5kg) (g) Full-arc extension (3 bouts of 10 reps) (h) Kinesio Taping

Table 3: Paired t-test for Outcomes at baseline and after 6 weeks of intervention

OUTCOME	PRE RX (T0)	POST Rx (T6)	T	P-value
		X±SD		
VAS		2.60±0.89	4.80	.009*
WOMAC (%)	51.80±10.78	21.40±6.69	12.78	.0001*
GROC	-3.00±0.00	5.00±0.71	-25.298	.001*
Knee extension ROM (degrees)	7.40±2.51	2.00±2.12	13.50	.001*
Knee flexion ROM (degrees)	119.00±11.40	128.60±10.95	-5.86	.054
QUADS Strength	3.60±0.55	4.80±0.45	-6.00	.054

**Significant at p<0.05*

3. RESULT

The result showed a significant improvement in pain intensity, functional limitation, extension ROM and general perception of recovery in all the outcomes when the pre-test and post-test scores were compared ($p<0.05$). However, there was no significant difference in the scores of the knee flexion ROM and the quadriceps gross muscle power when the pre-test and post-test scores were compared ($p>0.05$) (see Table 3).

4. DISCUSSION

Knee osteoarthritis (OA) is a major public health issue because it causes chronic pain, reduces physical function and diminishes quality of life. Ageing of the population and increased global prevalence of obesity are anticipated to dramatically increase the prevalence of knee OA and its associated impairments.[9,10]

Many treatment modalities, including therapeutic exercises and Kinesio Taping (KT) among others, have been suggested for the management of knee OA. Previous studies', have shown that therapeutic exercises have the ability to improve knee function by speeding up cartilage production through mechanotransduction. On the other hand, KT has been shown to reduce knee pain by improving patellofemoral alignment and lowering mechanical stress on soft tissues and thus improving myofascial flexibility and function.'

However, not all OA patients may respond to specific treatment equally due to selective target of the therapies[5]. In addition, even though studies tend to show positive effects with the use of exercises[5,8,15] or KT[11-14] independently, there is tendency for patients to make faster recovery with increased treatment satisfaction and functional benefits if different therapies are combined.[5]In this study, we investigated the effectiveness of a case series of six weeks program of combined KT and CCEs in individuals with moderate to severe chronic knee OA with a mean age of 44.58 years and mean BMI of 27.62kg/m.[2]

The outcome of this study showed a significant improvement in pain intensity, functional limitation, extension ROM and general perception of recovery in all the participants when the pre-test and post-test scores were compared. This could have been due to the wide differences in each participant' scores in all the aforementioned outcomes which showed that, there was an improvement in all these outcomes and that a combination of KT and CCEs is effective in the management of knee OA. However, there was no significant difference in the scores of knee flexion ROM and the quadriceps gross muscle power when the pre-test and post-test scores were compared. This could have equally been due to the narrow differences in each participant's scores in all the measured outcomes which showed that there was no improvement in these outcomes and that a combination of KT and CCEs conferred no increased in knee flexion ROM or quadriceps muscle strength. These findings are however similar to the findings of Bokaein et al. .[15] which concluded in their study that reduction in pain and improvement in functional activity occurs independently from an increase in quadriceps muscle strength in knee OA.

The findings of this study are also unique and different from those of previous studies [4,6,7,16,] because of differences in treatment protocols and outcome measures. For example, Castrogiovanni et al.[7] have examined the effects of a combination of KT and some forms of exercises which they termed moderate adaptive exercises on physical limitation in individuals with knee OA. In addition, other studies[4,6,15,]did not include therapeutic exercise programs in their treatment protocols which the present study was able to do. Therefore, for the first time, this study investigated the effectiveness of a combination of KT and CCEs in patients with knee OA.

5. CONCLUSION

The findings of this study concluded that a six (6) weeks program of Kinesio Taping (KT) and Combined Chain Exercises (CCEs) is effective for the improvement in pain, functional limitation, extension range of motion (ROM) and general perception of recovery in individuals with knee osteoarthritis.

6. RECOMMENDATIONS

It was recommended that a larger study, after obtaining appropriate ethical approval, may be done to determine the efficacy of this form of treatment.

Funding Source: No any funding received for this study.

Conflict of Interest:The authors declare that they do not have any competing interest.

REFERENCES

1. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, Christy W, Cooke TD, Greenwald R, Hochberg M, et al. Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. *Arthritis Rheum.*1986 Aug;29(8):1039–1049.
2. Musumeci G, Szychlinska MA, Mobasheri A. Age-related degeneration of articular cartilage in the pathogenesis of osteoarthritis: molecular markers of senescent chondrocytes. *Histol Histopathol*. 2015;30(1):1-12. DOI:10.14670/HH-30.1
3. Kalron A, Bar-Sela S. A systematic review of the effectiveness of Kinesio Taping--fact or fashion? *Eur J Phys Rehabil Med*. 2013;49(5):699-709. http://www.ncbi.nlm.nih.gov/pubmed/23558699. Accessed July 29, 2018.
4. Anandkumar S, Sudarshan S, Nagpal P. Efficacy of Kinesio taping on isokinetic quadriceps torque in knee osteoarthritis: a double-blinded randomized controlled study. *Physiother Theory Pract*. 2014;30(6):375-383. DOI:10.3109/09593985.2014.896963.
5. Bartholdy C, Juhl C, Christensen R, Lund H, Zhang W, Henriksen M. The role of muscle strengthening in exercise therapy for knee osteoarthritis: A systematic review and meta-regression analysis of randomized trials. *Semin Arthritis Rheum*. 2017;47(1):9-21. DOI:10.1016/j.semarthrit.2017.03.007.
6. Kocyigit F, Turkmen MB, Acar M, et al. Kinesio taping or sham taping in knee osteoarthritis? A randomized, double-blind, sham-controlled trial. *Complement Ther Clin Pract*. 2015;21(4):262-267. DOI:10.1016/j.ctcp.2015.10.001.
7. Castrogiovanni P, Di Giunta A, Guglielmino C, et al. The Effects of Exercise and Kinesio Tape on Physical Limitations in Patients with Knee Osteoarthritis. *J Funct Morphol Kinesiol*. 2016;1(4):355-368. DOI:10.3390/jfmk1040355.
8. Olagbegi OM, Adegoke BOA, Odole A. Effectiveness of combined chain exercises on pain and function in patients with knee osteoarthritis. *Bangladesh J Med Sci*.

2016;15(2):178-188. DOI:10.3329/bjms.v15i2.24808.
9. Arden N, Nevitt MC. Osteoarthritis epidemiology. *BestPract Res ClinRheumatol.2006;***20**(1), 3-25.
10. Giunta, S.; Castorina, A.; Marzagalli, R.; Szychlinska, M.A.; Pichler, K.; Mobasheri, A.; M u s u m e c i , G . Ameliorative effects of PACAP against cartilage degeneration. Morphological, immunohistochemical and biochemical evidence from in vivo and Invitro models of rat osteoarthritis. Int. J. Mol. Sci. **2015**, 16,5922–5944.
11. Anandkumar, S.; Sudarshan, S.; Nagpal, P. Efficacy of Kinesio taping on isokinetic quadriceps torque in knee\osteoarthritis: A double-blinded randomized controlled study. Physiother. Theory Pract. **2014**, 30, 375–383.
12. Halski, T.; Ptaszkowski, K.; Słupska, L.; Paprocka-Borowicz, M.; Dymarek, R.; Taradaj, J.; Bidzi ´ nska, G.; Marczy ´ nski, D.; Cynarska, A.; Rosi ´ nczuk, J. Short-term effects of kinesio taping and cross taping application in the treatment of latent upper trapezius trigger points: A prospective, single-blind, randomized, sham-controlled trial. Evid. Based Complement. Altern. Med. **2015**, 2015, 191925.
13. Mutlu, E.K.; Mustafaoglu, R.; Birinci, T.; Razak Ozdincler, A. Does kinesio taping of the knee improve pain and functionality in patients with knee osteoarthritis? A randomized controlled clinical trial. Am. J. Phys. Med. Rehabil. **2016**.
14. Kocyigit, F.; Turkmen, M.B.; Acar, M.; Guldane, N.; Kose, T.; Kuyucu, E.; Erdil, M.Kinesio taping or sham taping in knee osteoarthritis? A randomized, double-blind, sham controlled trial. Complement. Ther. Clin. Pract. **2015**, 21, 262–267.
15. Bokaeian, HR, Bakhtiary, AH, Mirmohammadkhani, M, Moghimi, J. (2018). Quadriceps strengthening exercises may not change pain and function in knee osteoathritis. JBodywMov Ther; 22(2), 528-533.
16. Crossley KM, Vicenzino B, Lentzos J, Schache AG, Pandy MG, Ozturk H, Hinman RS. Exercise, education, manual-therapy and taping compared to education for patellofemoral osteoarthritis: A blinded, randomised clinical trial. *Osteoarthr. Cartil.* ***2015***; 23, 1457-1464.