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Original Research Article

EFFICACY OF NEUROMUSCULAR TAPING ALONG WITH CONVENTIONAL PHYSICAL THERAPY IN POST AMPUTATION PHANTOM PAIN MANAGEMENT: AN EXPERIMENTAL STUDY

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ABSTRACT

Background: Neuro Muscular Taping (NMT) is a biomechanical therapy method using decompressive and compressive stimuli to obtain positive effects in the musculoskeletal, vascular, lymphatic and neurological systems. Application of an elastic tape on the skin will evoke direct therapeutic effect both local and distant by reflex. The application of NMT with an eccentric and decompressive technique rises the skin and dilates the interstitial spaces and consequently improves circulation and absorption of liquids reduces subcutaneous pressure. The aim of this study is to assess the efficacy of Neuromuscular taping on the treatment of Phantom pain in post amputation subjects in Mekelle ortho-physiotherapy centre, Physiotherapy Department, Tigray region, Northern Ethiopia, 2015-16.

Materials and Methods: The study population consisted of 32 subjects between 10 and 80 years of age. Subjects who underwent lower limb amputation and having phantom pain syndrome in Mekelle-ortho physiotherapy center, Mekelle and meeting the inclusion criteria were included in the study. The 32 subjects were allocated in to two groups of which, one is experimental group (16 subjects who were treated with neuromuscular taping treatment along with conventional physiotherapy) and second control group (16 subjects who were treated with conventional physiotherapy alone).

Results: To check the effectiveness of neuromuscular taping, the results of both groups were compared with each other i.e. between the groups it revealed a statistical association, i.e. (df =16, p=0.005 level, group A= 0.059 & group B =0.501). These finding clearly suggested that for lower limb amputation patient conventional physiotherapy is effective in reduction of pain but along with neuromuscular taping it stands to very effective in reducing phantom pain in post amputation subjects and VAS scale parameters reduction resulted in 6-7 treatment sessions that is less than in 8-10 treatment sessions when compared to control group.

Conclusion: To conclude the results using the conventional physiotherapy with neuromuscular taping in the management of phantom pain in lower limb amputation subjects were found to be very effective than conventional physiotherapy alone. Hence, it is highly recommended that neuro muscular taping can be included in the treatment protocol for lower limb amputation subjects having phantom pain syndrome along with conventional physiotherapy.

KEY WORDS: Neuromuscular Taping, Phantom Pain, Chronic Pain, Physical Therapy, Conventional Physical Therapy Management, Pain Management, Physiotherapy.

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BACKGROUND

Neuro Muscular Taping (NMT) is a biomechanical therapy method using decompressive and compressive stimuli to obtain positive effects in the musculoskeletal, vascular, lymphatic and neurological systems. As the tapes form wrinkles, lifting the skin, they facilitate venous and lymphatic drainage, improve blood circulation, and relieve pain. They also correct the alignment of joints, support muscles during movement, and improve stability and posture. The NMT concept has five major functions: Removes congestion of body fluids, activates endogenous analgesic systems, corrects joint problems, muscle support, and scar treatments [1].

Neuromuscular Taping often provides a solution in difficult situations, in acute stages, and in functional rehabilitation to reduce pain and inflammation. Results can be seen in a wider range of motion, with less pain and discomfort, facilitating the rehabilitation of patients. While most surgical patients go through a waiting period before rehabilitation can start, the NMT treatment protocol can be applied immediately after the surgery to treat hematoma and edema. Which cuts down the waiting period by more than half and so patients can start rehabilitation much sooner [2].

Over the last 5 years in Europe proprioceptive NMT technique has become a mainstream treatment protocol in post-operative, oncology, neurological care of patients and in sports medicine [3]. This innovative taping application is based on eccentric stimulation of the skin, muscle tissue, tendons, neurological vessels, lymphatic and vascular pathways improving their functioning. NMT provides passive stretching through the application of a tape with eccentric (opposed to concentric) properties encouraging flexibility and coordination and bettering range of movement in patients suffering with excessive muscle contraction due to different clinical conditions. It has been claimed that the effects may be due to the motor sensory and proprioceptive feedback mechanisms. It has been hypothesized that the application of NMT is able to stimulate cutaneous mechanoceptors. These receptors activate nerve impulses when mechanical loads (touch, pressure, vibration, stretch and itch) create deformation. Their activation by an adequate stimulus causes local depolarization, which triggers nerve impulse along the afferent fibres travelling toward the central nervous system. NMT is a relatively new treatment which induces micro-movements by stimulating receptors in the skin. It is commonly used in the sports traumatology as well as patients with Multiple Sclerosis [4]. Application of an elastic tape on the skin will evoke direct therapeutic effect both local and distant by reflex. The application of NMT with an eccentric and decompressive technique rises the skin an dilates the interstitial spaces and consequently improves circulation and absorption of liquids reduces subcutaneous pressure [5].

Applications of this technique were found in multiple sclerosis [6] and in Cerebral Palsy [7] with encouraging results on gait pattern and upper limb functionality. Results were also found to support the use of this type of taping application to improve the lower-limb functionality in subjects with JHS/EDS-HT. The aim of this case study was to use motion analysis approach to evidence, in a quantitative way, the biomechanical alterations in terms of gait strategy induced by the NMT intervention in a patient with JHS/EDS-HT [8]. Also a pilot study and case series on sensorimotor deficits in Down Syndrome, the aim is to use motion analysis approach to evidence, in a quantitative way, the biomechanical alterations in a drawing test through the application of NMT: the drawing test permitted the participants to focus their attention on a distal joint, where the contribution of skin receptors in kinesthesia assumes relevance as the muscle spindles usually have [9].

These study specific application processes of a NMT in specific therapeutic areas it has already been shown a certain improvement in mobility and lymphatic drainage [10-12]. The study was focused on neuro-rehabilitation, quantifying the efficacy of Neuromuscular Taping as a treatment method combined with physical therapy rehabilitation as a means of reducing pain symptoms in post amputation of lower limb subjects.

Amputation of lower limb causes a series of changes and concomitant adjustments which are related not only to the mutilated limb but also to the entire body [13-16]. Phantom pain sen-

sation is one of the main complications after any lower limb amputation. a study done on lower limb amputation subject suggests, 48.1% of the sample experienced residual limb pain and 69.2% experienced phantom limb pain. While fewer people experienced residual limb pain, those who did, experienced it for longer periods, at a greater level of intensity and with a greater amount of interference in their daily lifestyle, than people who were experiencing phantom limb pain. The experience of residual limb pain was associated with other medical problems and low levels of Adjustment to Limitation. Phantom limb pain was associated with older age, being female, above knee amputation, causes other than congenital causes, not receiving support prior to the amputation, the experience of other medical problems, low scores on Adjustment to Limitation and high scores on Aesthetic Satisfaction with the prosthesis [17].

Limb loss is a potentially devastating event in a person's life, often resulting in profound physical, psychologic, and vocational consequences. Despite the potential adverse impact of partial loss, total loss, or deficiency on everyday function and quality of life, precise figures on the incidence of limb loss and limb deficiency are not currently available. Most amputations in the developed world result from peripheral vascular disease including diabetes, but there are a small number necessitated by trauma, chronic infections, tumours and congenital defect [18,19].

In Ethiopia, amputation of a limb was a very common treatment procedure for many traumas, due to lack of medical facilities and unreachable to every population across the country. Vascular disease, apart from diabetes, is less common and amputation is often the only available treatment for the late results of trauma; mainly for late complications, for gangrene of various causes, for tumours and for chronic infections [20]**.** Upper limb amputations (ULA) were performed for 27 (25 %) of the patients and lower limb amputations (LLA) for 83(75%). Amputation was performed for Trauma (40%), Gangrene of various causes (32 %), Tumour (17 %), and Infections (1 1%) [21].

In many low income countries especially in Ethiopia lack of knowledge about the effect of physiotherapy services and having an attitude that physiotherapy is giving massage only, results in patients long term disability, dependency and increase in number of handicaps [22]. In 1994, Ethiopian national population and housing census provides statistics on disability in Ethiopia. This report revealed the total number of Ethiopians living with a disability to be 991,916 or 1.85% of the total population [27]. Of these, 319,181 were physically disabled. It is acknowledged, however, that this census is likely to have underestimated the prevalence of disability in Ethiopia. In 2003, it was estimated that 7.6% of the population were living with a disability [23]**.**

Other study conducted in Ethiopia suggested that a total of 805492 disabled persons constitute 1.09% of the total population [26]. In addition, during the last twenty five years, the country has been suffering from external and internal conflicts that have precluded major foreign investments. The war-wounded disabled people are estimated at 22,000 persons [17]. War, poverty, ignorance, disease, harmful traditional practice and drought are the major causes of disability in Tigray region. The situation is especially aggravated by post civil war, inadequate nutrition, limited access to health care and absence of educational services, as well as by the high prevalence of harmful traditional practices. The presence of a disability can trap people in a life of poverty because of the barriers disabled people face to taking part in education, employment, social activities, and indeed all aspects of life [28].

Lack of knowledge about physiotherapy services specifically NMT directly affect access to get physiotherapy services. Conservative opinion may also influence health and economical status of the family member. Even when physiotherapy services are available, patient's who lack accurate information about the relevant treatment options may not get the service because they do not know they are eligible for the service. In many circumstances where patients are legally entitled to have physiotherapy services especially NMT, are not available for a range of reasons like health system problems (lack of trained providers, concentration of

facilities in urban areas, negative provider attitudes, use of inappropriate or outdated methods , lack of authorization for providers or facilities and cultural and over all poor socioeconomic status. This risky practice leads to increasing morbidity and mortality [29].

Neuromuscular taping has been used as a therapeutic material in Europe and USA since 10 years back, but it is new for a country Ethiopia as a whole. In order to include Neuromuscular taping in our physiotherapeutic protocol and introduce this material throughout the country we planned to measure its efficacy. The aim of this study is to assess the efficacy of Neuromuscular taping on the treatment of phantom pain in post amputation subjects in Mekelle ortho-physiotherapy centre, Physiotherapy Department, Tigray region, Northern Ethiopia, 2015-16.

MATERIALS AND METHODS

A short-term clinical study on effectiveness of neuromuscular taping along with conventional physical therapy protocol among post amputation subjects having phantom pain syndrome were assessed. The study population consists of 32 subjects between 10 and 80 years of age. Subjects who underwent lower limb amputation and received treatment of neuromuscular taping (NMT) and conventional physiotherapy in Mekelle-ortho physiotherapy centre, Mekelle and meeting the inclusion criteria were included in the study. Lower limb post amputation with phantom pain or having post amputation chronic pain syndrome due to several reasons were the inclusive factors used in the study.

Participants: A Total of 32 subjects were included in this study. After informed consent were obtained from 32 subjects, they were divided into two groups of group A & group B (Group A, n = 16; Group B, n = 16)) with each group having 16 subjects. Group A is considered to be the experimental group(subjects who were treated with neuromuscular taping treatment along with conventional physiotherapy) and Group B as Controlled group (subjects who were treated with conventional physiotherapy alone).

Treatment procedures: The desired treatment protocol (Conventional physiotherapy & neuromuscular taping) was given twice per week for minimum of 6 weeks and maximum of 8 weeks (8-10 treatment sessions). Both the groups were treated with conventional physiotherapy treatment for phantom pain management. In addition, the Experimental group were also treated with neuromuscular taping. Before the primary application of any treatment, VAS (visual analogue scale for pain scaling), and after each application the result of the treatment was evaluated. These procedures were continued till the end of the treatment sessions. Conventional physiotherapy treatment includes TENS, stump care protocol (Which includes, stump hygiene, stump strengthening, stump bandaging).

Statistical Analysis: Each parameter was computed for each patient before and after the treatment. The effects of the treatment were evaluated using statistical analysis. Data was anonymously coded and entered into Microsoft EXCEL sheet and exported to STATA 12.0; using the software the data was cleaned and analyzed. Descriptive analysis was performed for the categorical variables. In addition, percentages, frequencies and other summary statistics were calculated. To compare categorical variable with the outcome student-t and upaired-t test were used. Data findings were considered statistically association when revealing a p-value of 0.05 or less.

Ethical Consideration: Ethical clearance was obtained from the ethical review board of Mekelle University, College of health sciences. Confidentiality of the patient's status was maintained.

RESULTS

A total of (n=32) subjects with lower limb amputation who fulfill the inclusion criteria were recruited for this study. Among total subjects (n=32), 21 were male and 11 were female participants (Shown in Table 1). Another data represents the age distribution among the population included in the study (Shown in Table 2). The Subjects with 10 years to 80 years were the participants of this study.

Table 1: Baseline Description of demographical data (Sex) used in the study.

SEX (n=32)		Frequency	Percentage %	Valid Percentage %
Valid	Male	21	65.6	65.6
	Female	11	34.4	34.3
	Total	32	100	100

Table 2: Baseline Description of demographical data (Age) used in the study.

Age (n=32)	Frequency	Percentage %	Mean	Standard deviation
10-20	3	9.35	42.75	13.48
21-30	3	9.35		
31-40	8	25		
41-50	7	21.87		
51-60	9	28.12		
61-70	1	3.12		
71-80	1	3.12		

Socio-demographical Data: The total subject (n=32) were divided into two groups, Group 'A' [Experimental Group] & 'B' [controlled group] respectively, with 16 subjects in each group. Demographical data (Age) which is significant factor in the study were illustrated in each group A&B (shown in Table 3). The mean age of the groups is 42.75 and standard deviation (p=0.05) of 13.48.

Table 3: Description of demographical data (Sex) in each group A&B.

Group	Percentage %	
Sex (n=32)	Female	Male
A (n=16)	08 (50%)	08(50%)
B (n=16)	03(18.75%)	13(81.25%)

In Table 3 it elaborates about the gender of the subjects in each groups, Group A had 8 Female and 8 males subjects whereas group B had 3 female and 13 male subjects which were selected and grouped accordingly.

Table 4: Description of data the various Causes of Lower limb Amputation in both the groups.

S.No	Causes of Lower limb Amputation (n=32)	Cases reported	Percentage %
1	Infection	5	15.6
2	Trauma	17	53.12
3	Tumor	3	9.37
4	Metabolic disorders	5	15.62
5	Lack of treatment	2	6.25

This Table 4 illustrates the cause of amputation among the subjects, as per the data acquired which clearly suggests that the maximum percentage of lower limb amputation is due to trauma or accident. As the treatment area, which is a northern region of Ethiopia "Tigary", where it has a very long history of civil war and more casualties recorded. This also makes us understand the various causes of lower limb amputation for effective management and importance of rehabilitation.

Table 5: Description of data Lower limb Amputation sites in A&B the groups.

S.No	Site of amputation	Percentage %	
		Group A(n=16)	Group B(n=16)
1	Above knee	11(68.75%)	09(56.25%)
2	Below knee	05(31.25%)	07(43.75%)

According the data Table 5 it reveals about the site of amputation done for the subjects, which indicates majority of amputation cases are above knee procedure in both the groups when compared to below knee procedures which is also a key factor for having an influence on the management and rehabilitation for lower limb post amputation phantom pain syndrome.

Effectiveness of Interventions

Table 6: Group – A (Experimental Group).

Values	Test values		95% Confidence Interval of the Difference		t-Value
	Mean Values	Standard deviation	Lower	Upper	
Pretest	7.375	1.0247	6.829	7.921	0.032
Posttest	2.1875	1.22304	1.5358	2.8392	

After the administration of specific intervention to respective Groups, the results obtained are illustrated in Table VI. It reflects the comparative mean value, mean difference standard deviation and't' value between pre Vs post test of Pain(VAS) among subjects in group A (Experimental Group). Using paired't' test in the data ($t = 0.032$, $df = 16$) the result showed statistical significance at $p < 0.05$ level, therefore, it suggests that, the interventions given in this group is effective in reducing the parameter [Pain (VAS)] in group A.

Table 7: Group – B (Controlled group).

Values	Test values		95% Confidence Interval of the Difference		t-Value
	Mean Values	Standard deviation	Lower	Upper	
Pretest	5.75	1.48324	4.9596	6.5404	0.044
Posttest	0.875	0.80623	0.4454	1.3046	

Table 7 It shows the comparative mean value, mean difference standard deviation and 't' value between pre Vs post test Pain(VAS) among subjects in group B (Controlled Group). Using paired

"t" test in the data (t = 0.044, df = 16) the result showed statistical significance at p < 0.05 level, therefore, it suggests that the intervention given in this group is effective in reducing the parameter, Pain [VAS] in among subjects in group B.

Comparison between groups:

Table 8: Group – A and B (Pain (VAS)).

Values	Pair Differences				t- value	Significance
	Mean	Df	Standard. Deviation	F		
Group A	0.519	15 1.088	1.22304	0.477	7.154	0.059
Group B	5.207	15 1.231	0.80623	4.23	4.341	0.501

Table 8 reveals, after the statistical test on the data, unpaired't' test shows , a significant difference in t-value and level of significance between the group A (Experimental) (t=0.032, S*= 0.059) & group B (controlled) (t=0.044, S*= 0.501) of Pain (VAS) parameters. This suggests the fact that the administrated interventions in group 'A' are very effective in reduction of parameter pain (VAS) when compared to group 'B'.

Effectiveness of the treatment protocols: To further elaborating the result, statistical test suggests that in group 'A' i.e after the application of conventional physiotherapy and neuromuscular taping on lower limb amputation subjects, the pre-test versus post-test value differences showed relieving of phantom pain (VAS) score in 6-7 treatment sessions. On the other hand in group 'B' the pre-test versus post-test value differences showed relieving of phantom pain (VAS) score in 8-10 treatment sessions.

DISCUSSION

The results of this study show an evidence of reduction of phantom pain (VAS). In general, when compared within the group the pre-test mean of VAS pain is 7.375 and post-test mean of VAS pain is 2.1875, this clearly indicate that there is a reduction of pain before and after the treatment. Later using statistical tool, paired 't' test in the data (t =0.032, df = 16) the result showed statistical significance at p <0.05 level, therefore, it suggests that, the interventions (Conventional physiotherapy treatment and neuromuscular taping) given in this group is effective in reducing the parameter [Pain (VAS)] in group A.

In group B when compared within the group the pre-test mean of VAS pain is 5.750 and post-test mean of VAS pain is 0.8750, this clearly indicate that there is a reduction of pain before and after the treatment. Later using paired't' test in the data (t =0.044, df = 16) the result showed statistical significance at p <0.05 level, therefore, the this suggests that the intervention (Conventional physiotherapy treatment alone) given in this group is effective in reducing the parameter, Pain [VAS] among subjects in group B. From these result, it can be concluded that both the treatment protocol is effective in reducing phantom pain in post amputation subjects.

In order to check the efficacy of the neuromuscular taping among the two groups, the two groups data are compared and the results between the groups reveals that, in unpaired't' test (s=0.059, df=16) in group A (experimental) found to be more significance in reduction of pain parameter scale when compared to group B (controlled) (s=0.501, df=16). Moreover, the average pain relieving time taken in group A is 6-7 treatment sessions whereas in group B it is 8-10 treatment sessions.

Hence, it can be concluded as conventional physiotherapy are effective in reduction of phantom pain in post amputation subjects. But, when neuromuscular taping along with conventional physiotherapy is administered which seems to be very effective in few treatment sessions. This clearly indicates the efficacy of neuromuscular taping in reduction of pain in post amputation subjects. With the results, available from this study it can be recommended that neuromuscular taping can be added as treatment option along with conventional physiotherapy protocol for lower limb amputation subjects for reducing the phantom pain syndrome.

In contrast with NMT application was also shown to be effective as follows, it is noninvasive and is not a time-consuming Procedure; thus, it is cost-effective while not requesting specific patient collaboration. Its hypothetical mechanism of action, if merely speculative, should be that NMT may play a role as a sensitive input that is integrated by the central nervous system and used for assisting motor program execution process known as sensorimotor

integration. It has recently has been hypothesized that taping seems to stimulate cutaneous mechanoreceptors resulting in physiological changes in the taping area [26].

Moreover, we cannot compare our result with other literature results because this study represents a first case attempt to quantify NMT with post amputation phantom pain syndrome. No other studies which comes in contrast with this current study.

CONCLUSION

In conclusion, the results of both group were compared with each other i.e. between the groups A&B, and it shows a statistical significance i.e (df =16, p<0.05 level, group A= 0.059 & group B =0.501). These finding suggested that for lower limb amputation patient conventional physiotherapy is effective in reduction of pain but along with neuromuscular taping it stands to be very effective in reducing post amputation phantom pain. Hence, it stands very effective if we include neuromuscular taping along with conventional physiotherapy in the management of post amputation phantom pain syndrome.

Recommendation: This study can be used as a pilot study and more studies are recommended to be conducted on these and related topics so that the concept of neuromuscular taping can be incorporated in many musculosketal cases for effective rehabilitation. For the further studies, it is recommended to include more subjects to be tested for better understanding the neuromuscular taping.

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ABBREVIATIONS

NMT- Neuromuscular taping
VAS- Visual analogue scale
TENS- Transcutaneous Electrical nerve stimulation
LLA- lower limb amputation
ULA- upper limb amputation

Conflicts of interest: **None**

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