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Six-Month Work Related Musculoskeletal Disorders Assessment During Manual Lymphatic Drainage: A Physiotherapist Case Report

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ABSTRACT

Background: Physiotherapists have a high prevalence of musculoskeletal disorders (MSDs). The duration and repetition of a treatment over a period of 6 months was not addressed. The interest of such an approach is to identify the biomechanical and ergonomic parameters that would lead to the appearance of MSDs.
Purpose: The aim of this case study was to investigate the MSD risk of musculoskeletal disorders associated with the practice of manual lymphatic drainage through the analysis of postures over a period of 6 months.
Participant(s) and Methods: A 39-years physiotherapist performed ten 20-minutes manual lymphatic drainage. The adopted postures were defined every 5 seconds by the joint angles of the neck, trunk, and upper and lower limbs. A hierarchical cluster analysis was applied to identify "Personal Postural Clusters" (PPC). The MSD risk related to each PPC was quantified using the Rapid Upper Limb Assessment (RULA).
Results: Six PPC were identified and defined though mean (± standard deviation) joint angles. Associated RULA scores were between 4.2 and 5.5. The three PPC with the highest MSD risk were used for 48% of the massage time. The shoulders and back were the most exposed areas to MSDs.
Conclusion: Manual lymphatic drainage activities over a long period of time expose physiotherapists to significant risks of MSDs. Quick changes are needed to prevent their occurrence. The use of PPCs in a quantitative and longitudinal analysis of manual lymphatic drainage enables the quantification of individual risks and the proposal of recommendations.

Keywords: Musculoskeletal disorders, Physiotherapy, Ergonomics

INTRODUCTION

Musculoskeletal disorders (MSDs) are alterations of the articular and muscular systems that cause pain and restrictions of movement. They are induced by awkward static postures frequently repeated with insufficient rest and involving high levels of force. Health professionals such as physiotherapists reported high prevalence rates in several countries: 91% in Australia [1], 68% in the United Kingdom [2], 96% in the United States [3], 82.6% in Egypt [4], 92% in Korea [5].

Numerous works have been conducted to study the factors responsible for the appearance of these work-related MSDs in this population. Several risk factors have been identified such as “Bending or twisting forward”, “Working in a same position for a long time”, “Working in an awkward/cramped position”, and “Performing manual therapy techniques” [2, 6, 7]. These same factors also would

contribute to exacerbate MSD symptoms [8, 9]. Prevalence of MSDs has also been mapped by body areas. The authors showed that the upper extremities as well as the neck, back, and shoulder were especially exposed [1, 2, 10]. However, the results were obtained throughout subjective approaches, i.e. questionnaires, to assess the presence of MSDs. Very few objective analyses of postures are present in the literature. Quantifying joint angles provides an assessment of MSD risks, particularly through the use of ergonomic tools that integrate posture and activity factors [11-13]. The Rapid Upper Limb Assessment (RULA [13]) is one of the most appropriate tools for assessing MSD risk in occupational activities [14]. In addition, it focuses mainly on the neck, trunk and upper limbs to quantify the MSD risk of a posture, which corresponds to the areas most exposed to MSDs among physiotherapists. On the other hand, the responses given in the questionnaires were based on an overall view of practice. However, the activities practiced by physiotherapists are very diverse and varied. Some of them, such as manual therapies (massage) or transfers, require a heavy workload from the physiotherapists and are considered to be major risk factors [5, 15]. Other activities consist of supervising the patient's work and therefore involve them less physically. This is a remediation that is often reported by physiotherapists who suffer from MSDs that affect their work habits [16].

The objective of this case study was to investigate the risk of MSDs associated with the practice of a manual therapy, i.e. manual lymphatic drainage, through the analysis of postures (application of the RULA) over a 6-month period. The hypothesis would be that the risk of MSDs over the 6-month period, given the experience of the physiotherapist, would be low to moderate.

MATERIALS & METHODS

A 39 year old female physiotherapist (156 cm, 70 kg), right handed, was followed in her daily work activity for 6 months. She works full time 5 days a week, and spends an average of 7 hours a day in contact with patients. She has 19 years of experience, including 7 years in her current neurology department at the Léon Bérard Hospital. She spends 1/7 of her working time giving massages and the rest depends on her patients' pathologies. She practices transfers, segmental mobilizations as well as physical activities. She did not suffer from any pathology of the musculoskeletal system limiting her movements. She was informed of the complete procedure of the experiment and gave her written informed consent before the beginning of the study. The protocol has been approved by the local ethics committee was in agreement with the Helsinki declaration [17].

The study focused on Manual Lymphatic Drainage (MLD). This technique is usually used with clients who have an accumulation of lymphatic fluid in an upper or lower extremity. Studies have shown that MLD significantly reduces the volume of edema and associated pain [18]. The patient was in a semi-sitting or lying position on a massage table. The physiotherapist exerted repeated pressure of less than or equal to 60 mmHg without sliding on the limb for 20 minutes. The massage was performed in a sitting position on a backless rolling stool. Two digital cameras were placed to film the physiotherapist frontal and sagittal planes directly within her department. Ten manual lymphatic drainages were recorded.

Each recording was sampled with a 5-second interval. Two experts quantified the physiotherapist's posture on each sample image, i.e. a total of 2371 postures (approximately 230 postures per massage). First, the body was modelled by rigid segments on each record representing head, trunk arms, forearms, thighs, and legs. Then, each posture was defined by the following joint angles: neck, trunk, shoulders, elbows, hip and knee flexion or extension; neck and trunk inclination; shoulders and hips abduction or adduction. The RULA was used to assess the risk of MSD occurrence for each posture.

Statistical Analysis

A hierarchical cluster analysis (HCA) was applied to the 2371 postures using Statistica software (Statistica 7.1, Statsoft, Tulsa, OK, USA) to bring out groups with similar postures. All joint angles were used as input data and the software automatically matched the postures based on the information of distances between the data using Ward's linkage method [19]. The results of the agglomeration were illustrated by a dendrogram. The identification of the clusters was quantitatively determined by the agglomeration coefficient and this decision was validated by a visual inspection of the dendrogram. Each cluster, called "Personal Posture Cluster" (PPC), represents an average user's postural strategy used to perform MLD and contains the number of times it was observed during the massage.

RESULT

With an agglomeration coefficient of 39.0% of the data variance, six PPC were identified by the HCA (Figure 1). Each PPC was represented by a mean posture (±standard deviation). Table 1 illustrates the mean joint angle values (±standard deviation) of each of these six PPC. PPC3 had the lowest MSD risk (RULA score of 4.2) while PPC4, PPC5, and PPC6 had the highest risk (RULA scores of 5.4, 5.5, and 5.5, respectively). For the latter, trunk flexions were the most important (>15°) coupled with inclination and rotation. The shoulders were also significantly involved, especially in flexion (>45°). PPC4 and PPC5 had high neck flexion (>20°) with inclination only for PPC4.

Table 2 detailed the time spent in each PPC for all 2371 postures studied as well as by MLD. The results showed that postures PPC2 and PPC4 were the most used by the physiotherapist (respectively 22% and 30% of the time) and PPC6 was the least represented (6% of the time). The other three PPC had a rate of use between 12 and 17%. The physiotherapist showed great variability in the use of PPC during the different MLD. Three of the massages were performed with only one (M2) or two (M1, M4) PPC while the others used at least 3 different PPC. PPC3 and PPC6 were the least used postures in the massages (respectively in 2 and 1 massage).

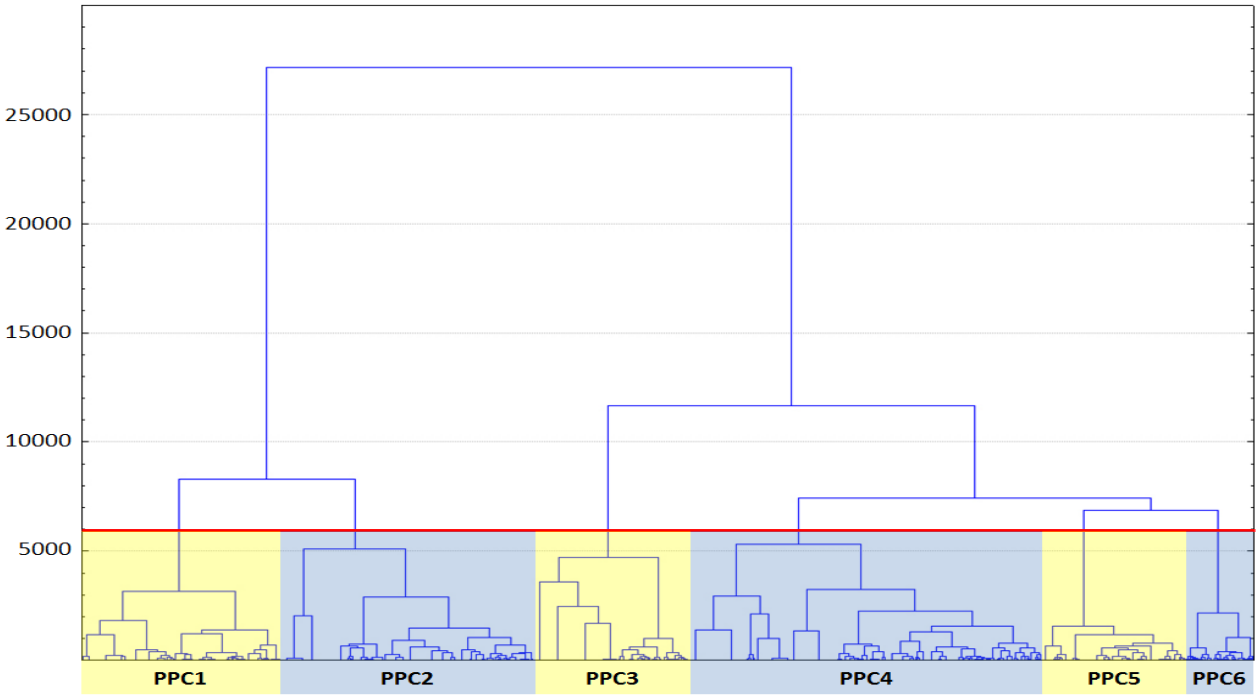

Figure 1: Ward's minimum variance linkage dendrogram of the hierarchical cluster analysis representing the six-cluster solution. PPC = Personal Postural Cluster.

Table 1: mean ±standard deviation of each joint angle (°) by PPC used during MLD identified by the HCA.

	PPC1	PPC2	PPC3	PPC4	PPC5	PPC6
Neck flexion	27.2±7.8	25.7±8.2	15.0±4.5	24.5±6.5	21.1±10.0	16.4±7.2
Neck inclination	1.9±0.3	9.1±12.0	1.1±1.9	9.8±12.1	2.1±1.4	2.0±1.6
Trunk flexion	10.6±4.8	13.9±6.1	12.6±6.4	15.7±7.6	18.0±8.0	16.7±7.5
Trunk inclination	9.2±7.8	13.0±8.5	3.7±5.7	15.6±9.7	8.6±6.8	6.0±4.8
Shoulder flexion	7.9±6.4	23.3±11.6	47.2±15.9	46.3±12.3	71.0±9.1	48.5±28.1
Shoulder Abduction	11.5±8.3	46.5±18.9	23.9±23.0	16.2±11.8	11.6±7.8	15.8±12.5
Elbow Flexion	89.8±9.8	78.9±9.9	59.0±22.6	45.7±16.3	18.3±10.7	34.1±25.4
Hip Flexion	84.9±4.4	79.8±4.3	78.6±20.5	81.6±9.3	83.5±5.1	136.9±3.1
Hip Abduction*	-4.7±8.7	-3.2±5.6	30.7±10.6	-2.5±11.0	-5.2±6.3	-18.0±6.1
Knee Flexion	87.2±10.0	80.3±6.3	111.4±13.5	81.9±15.5	84.4±8.4	83.4±7.9
RULA Score**	4.5±0.6	5.0±1.0	4.2±1.1	5.4±1.1	5.5±1.0	5.4±1.3

* Negative values for hip abduction correspond to adduction (crossed leg position).
** Rotation adjustments were incorporated into the RULA computation from the video analyses.
PPC = Personal Postural Cluster; MLD = Manual Lymphatic Drainage; HCA = Hierarchical Cluster Analysis

Table 2: rate of use (%) of each PPC for each MLD.

		Mean posture					
	Number of posture	PPC1	PPC2	PPC3	PPC4	PPC5	PPC6
Massage 1	278	0.0%	0.0%	50.4%	0.0%	0.0%	49.6%
Massage 2	173	0.0%	0.0%	97.7%	2.3%	0.0%	0.0%
Massage 3	332	6.9%	70.8%	0.0%	6.3%	16.3%	0.0%
Massage 4	351	0.3%	35.3%	0.0%	64.1%	0.0%	0.0%
Massage 5	229	36.2%	10.5%	0.0%	30.1%	23.1%	0.0%
Massage 6	184	65.2%	7.6%	0.0%	16.3%	10.9%	0.0%
Massage 7	229	34.5%	23.1%	0.0%	19.2%	23.1%	0.0%
Massage 8	240	15.8%	17.9%	0.0%	29.2%	37.1%	0.0%
Massage 9	190	19.5%	3.2%	0.0%	77.4%	0.0%	0.0%
Massage 10	165	11.5%	9.7%	0.0%	64.8%	13.3%	0.0%
TOTAL	2371	17%	22%	13%	30%	12%	6%

PPC = Personal Postural Cluster; MLD = Manual Lymphatic Drainage.

DISCUSSION

The objective of this work was to evaluate the risks of MSDs associated with the practice of MLDs in a simple and rapid way using an ergonomic task analysis (RULA). For this purpose, the postures adopted every 5 seconds by the physiotherapist during 10 MLD performed over a 6-month period were studied, i.e. a total of 2371 postures. This temporal analysis completed the standard MSD risk evaluation with the variations in risk level during each massage. Repetition of several MLDs allowed the practitioner's habits to be assessed and modified if necessary to reduce exposure to MSDs.

The HCA identified 6 PPC of MLDs for the physiotherapist. The ergonomic analysis showed that the MSD risks associated with each PPC were between 4 and 6. Scores of 4 are associated with a rather low risk but with changes to be considered, whereas those above 5 reflect a medium risk with changes to be planned quickly. Three of the 6 PPC reached a high score of 5.4 and 5.5 (PPC4, PPC5 and PPC6). This result illustrated that physiotherapist was exposed to significant MSD risks and adaptations must be proposed in the short term. The different joint values associated with each of these three PPC highlighted that the trunk and shoulder regions were the main cause of high MSD risk. Indeed, high trunk flexions (>15°) associated with inclinations and rotations are postures that cause pain as illustrated by the RULA rating table [13]. High shoulder flexions coupled with small elbow flexions, particularly for PPC5, resulted in awkward postures responsible for high MSD risks for this joint. These results are in line with other results proposed for physiotherapists [20]. Albert et al. (2006) reported that shoulder, trunk and elbow flexions were mild to severe for a significant portion of 44 -minute massages, which would expose physiotherapists to a risk of cumulative musculoskeletal disorders. However, these results are contrary to those proposed in other massage studies. Yoopat et al. (2018) did not identify a risk of MSD in Thai massage practice. It is likely that the conditions under which massage is practiced and the issues (care

versus well-being) have a different impact on practitioners.

These observations are also in agreement with the information available in different subjective surveys conducted among physiotherapists in different countries. Prevalence rates of 33-62% and 62-66% have been reported for the lower back and shoulder respectively [1, 3, 5, 23]. It is therefore appropriate to propose adaptations mainly for these two body regions to significantly reduce the MSD exposure. Good positioning in relation to the patient favouring straight back posture could reduce these risks by modifying the table height [20]. Moving away from the area to be massaged could also reduce shoulder joint angles and thus limit exposure to MSDs such as in PPC1.

The temporal analysis also showed that the most risky postures were used for almost half the time by the physiotherapist (48% of the total massage time). Over this period of time, PPC4 (posture with one of the highest RULA scores) was the most used by the physiotherapist (30% of the massage time), despite her almost 20 years of experience. On the contrary, the PPC3 (posture with lowest RULA scores) was used for only 13% of the time. These results suggest that there was no continuity in the massage execution. Indeed, the same combination of PPC was not observed during the 10 MLD. This variation would have an impact on the MSD risk, as some massages were performed with suitable postures (e.g. Massage 2) and others with more awkward postures (e.g. Massage 4, table 2).

The strength of the proposed approach was the personalized assessment of MSD risks in the practice of MLD. Indeed, it allows to propose adjustments adapted to each practitioner to reduce his/her exposure to MSDs. One of the limitations is related to the diversity of activities performed by the physiotherapists. Indeed, even if the subject performs much drainage, her professional activity integrates many other care acts. Depending on the nature of these activities (transfers, massages, supervision of physical activities …), the MSD risks to which she is exposed may vary significantly. It might therefore be relevant to extend the analysis of postures to the whole day in order to have a representative evaluation of her daily activity.

CONCLUSION

In conclusion, it appears necessary to carry out studies over time for a correct evaluation of MSD risk. This approach allowed to highlight 6 PPC that synthesize the 2371 postures observed during 6 months. The results of this case study showed that MLD expose the physiotherapist to the development of MSDs, even when the postures adopted presented the lowest risks. It is relevant to propose postural or environmental adaptations to reduce the risk of MSDs associated with MLDs, particularly for the trunk and shoulders.

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