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Skin rolling technique as an indicator of spinal joint dysfunction*

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The use of the skin roll technique as an indicator of spinal joint dysfunction (fixations) has not previously been subjected to validity testing. This study was undertaken to determine the degree of correlation between the skin roll technique and spinal joint dysfunction in the thoracic spine.

Twenty-five (25) subjects reported tenderness to a paraspinal skin roll along the first ten thoracic vertebrae. At the tender areas elicited during the skin roll, a pressure algometer was used to determine the subject's pressure pain threshold. Static joint challenging as described by Maigne was utilized by an independent examiner to identify levels of spinal joint dysfunction in the first ten thoracic vertebrae in the same subjects. A moderate, but highly significant correlation (Kappa = 0.48, $p \leq .001$) was found relating a tender point on skin roll to a spinal joint dysfunction within one vertebrae above or below the level of the tender point. Pressure algometer readings revealed a highly statistically significant ($p \leq 0.0005$) decrease in pain threshold tolerance at the level of a tender skin roll as compared to control (non-tender) points.

These findings suggest a moderate level of support for the validity of the notion that spinal dysfunction is characterized by loss of joint motion and contiguous paraspinal tenderness.
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KEY WORDS: Skin roll technique, spinal joint dysfunction, chiropractic, pressure algometer, vertebral joint challenge, thoracic spine, manipulation.

L'emploi de la technique du massage de la peau comme indicateur d'un dysfonctionnement de la jointure spinale (fixations) n'a pas subi de test de validité. Cette étude a été entreprise pour déterminer le degré de corrélation entre cette technique et les dysfunctions de la jointure spinale dans la colonne dorsale.

Vingt cinq (25) sujets ont fait part d'une sensibilité à un massage de la peau paraspinale sur les dix premières vertèbres dorsales. Un algésimètre a été utilisé sur les parties sensibilisées pendant le massage de la peau, pour déterminer le seuil nociceptif à la pression. La provocation de la jointure statique, telle que décrite par Maigne, a été par un examinateur indépendant pour identifier le dysfonctionnement de la jointure spinale dans les dix premières vertèbres dorsales, chez les mêmes sujets. Une corrélation modérée, mais très importante (Kappa = 0,48, $p \leq ,001$) a permis de relier un point sensible de la peau roulée à une dysfonction de la jointure spinale sur une vertèbre au-dessus ou en-dessous du niveau du point sensible. Les lectures de l'algéstimètre ont révélé une diminution statiquement très importante ($p \leq 0,0005$) de la tolérance au seuil nociceptif au niveau de la peau massée sensible par rapport aux points de contrôle (non sensibles).

Ces constatations suggèrent un niveau modéré de soutien pour la validité de la notion que la dysfonction spinale se caractérise par la perte de mouvement de la jointure et par une sensibilité paraspinale contiguë.
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MOTS CLÉ: Technique de massage de la peau, dysfonction de la jointure spinale, chiropractie, algésimètre, provocation de la jointure vertébrale, colonne dorsale, manipulation.

Introduction

An important component of the chiropractic physical assessment is the determination of areas of spinal joint dysfunction. These areas have been associated with a decreased pain threshold of the paraspinal skin.[1,2,3,4,5] The skin rolling technique, as described by Maigne[6] is one of the methods that is used to locate areas of paraspinal skin which demonstrate a subjective decrease in pain threshold, amongst other clinical phenomena.

The causal relationship between spinal joint dysfunctions (fixations) and alterations of pain tolerance is supported by many authors.[3,4,7,8,9,10] Korr[2,11] reported that areas of spinal joint dysfunction demonstrated a segmentally sustained level of sympathetic hyperactivity which correlated well with deep and superficial skin tenderness. He concluded that a state of segmental chronic sympathetic facilitation was caused by spinal joint dysfunctions. Other authors[3,12] also agree that increased sympathetic outflow (facilitation) increases sensory firing and thus enhances pain.

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Wyke[7] noted the close morphologic relationship between the mechanoreceptors of joints and nociceptors in the somatic tissues. It was his opinon that any loss of normal sensory input from the mechanoreceptors in the joint capsule may result in various abnormalities, which include decrease in pain threshold. Numerous chiropractic authors suggest that this phenomenon occurs in the state of spinal joint dysfunction which has been termed "subluxation". (For further review see 4 and 18.)

Feinstein[9] stated that skin hyperalgesia to pricking or pinching (essence of skin rolling) has often been observed to accompany pain arising from visceral and somatic structures. The hyperalgesic areas are not random but are dermatomally situated corresponding to the cord level of the affected deep tissues.

The chronicity of spinal joint dysfunction and subsequent dermatomal decreased pain threshold may have a feedback effect on the pain receptors themselves. Slosberg[3] noted that not only are pain receptors of high threshold and non-adapting but they can actually have a lowering of their firing thresholds. Thus, less stimulus becomes necessary to activate the nociceptors.

The pressure algometer (dolorimeter) has been used by many researchers to reliably evaluate subjective tender points in pain patients.[10,13,14,15,16,17,21,23,24,25] This device enables the researcher to obtain quantitative measurement of a patient's pain threshold. Tunks *et al.*[13] have most recently confirmed that the hand-held pressure algometer is a reliable tool that can be used for clinical research into the tender point phenomena.

Terrett and Vernon[4] studied paraspinal tenderness in response to manipulation. They first determined a high association of tender spots with local spinal joint fixations. Of 54 tender spots, 50 had accompanying fixations. Half of the study received a spinal manipulation, while the other half received a sham mobilization. Cutaneous pain tolerance levels rose 140% in the treated groups as compared to 5% in the controls after 10 minutes. This finding was statistically significant.

Similarly, increases in myofascial pressure pain threshold have recently been reported by Vernon *et al.*[19,20] which average approximately 50% of baseline levels, confirming that manipulation of a spinal joint fixation can result in inhibition of pain transmission and reductions of local paraspinal tenderness.

The current literature, as cited above addresses the relationship between 1) spinal joint dysfunction with lowered skin segmental pain thresholds; and 2) the use of the skin rolling technique to locate areas of decreased pain threshold in paraspinal skin. However, no study has reported on the skin roll technique as a reliable method of detecting the locations of a spinal joint dysfunction. It is thus the purpose of this study to investigate the following two hypotheses, herein stated in the null:

H1 There exists no correlation between the level of skin roll tenderness and the level of a spinal dysfunction.

H2 There is no objective decrease in pain tolerance in the areas of skin roll tenderness relative to areas on non-tender skin roll.

Materials and methods

Twenty-five subjects were included in this study. There were 15 males and 10 females. The ages ranged from 20–73 years of age. The mean age was 27.5 years.

The study group consisted of a non-random selection of chiropractic patients already receiving treatment for mechanical pain syndromes in the dorsal spine at the Canadian Memorial Chiropractic College Outpatient Clinic. The only exclusion criterion necessary was that these patients had not received spinal manipulative therapy within the previous 24 hours. All subjects gave informed consent.

The following method was used: the subject was brought into a chiropractic examining room by Examiner A. The subject was placed prone on the examining table. Examiner A placed a small round adhesive sticker on the skin over each of the spinous processes of T1, T4, T7 and T10 as determined by palpation. These were kept in place throughout the entire examination so that each examiner had a common reference to indicate the spinal levels. Examiner A then told the patient: "I'm going to roll your skin between my fingers along your back. Please tell me if it feels that I'm pinching you in one spot more than another."

Examiner A then used both hands to lift the initial roll of skin on the left side of the subject at approximately two centimetres lateral from the midline at the level of the tenth dorsal vertebrae. The skin was then rolled in a continuous manner using both hands upward toward the first dorsal spinous process. According to Maigne,[6] this first pass serves to introduce the patient to the "feel" of the technique. The roll was then repeated twice more on the left. During the last two passes the subject was asked to report the "pinched" areas. Upon location of a tender area on the third pass, the painful skin was maintained between the fingers of one hand so as to keep the location for the algometer reading as stable as possible.

Using the pressure algometer, (according to previously reported protocols by Fischer[21] and Vernon[19]) Examiner A applied steady pressure over the tender spot while securing the skin between the thumb and first finger. The examiner requested the patient to indicate when there was a change from a pressure sensation to a sensation of pain. This point was then recorded in pounds/cm^2 as the pain threshold at the level of the tender skin roll.

Pain threshold levels of each of the tender points were successively measured with the pressure algometer in this manner by Examiner A. Readings were then recorded as to the spinous level at which they were measured. All pressure readings were completed on the left side before repeating skin roll and pressure readings on the right.

Randomly chosen areas of the right and left paraspinal regions from T1–T10 that were not reported as tender during the skin rolling technique were measured with the pressure algometer and recorded to give a control pain threshold value for that patient. These were located at least three segments above or below the tender spot. Examiner A took three to five minutes to

locate and record this data.

Examiner A then left the room and Examiner B entered. Examiner B then performed a lateral joint challenge from T1–T10. The lateral spinous challenge was performed with thumb pressure on a single spinous process first, with alternating contralateral apposition on the same spinous process (i.e. right to left challenge) and then with contralateral apposition on the segments above or below. The first method located a region of fixation, while the second method confirmed the specific segment. This joint challenge method was performed on each of the spinous processes of T1–T10. At each level where Examiner B determined a relative loss of joint play, it was recorded as a fixated segment (spinal joint dysfunction). The fixations were recorded by spinous levels only and irrespective of direction of the perceived fixation. The subject did not provide feedback as to whether any palpatory manoeuvre was painful. After Examiner B had recorded his findings, the patient was allowed to leave the room. Examiner B took approximately three minutes to locate and record the data. While this form of motion palpation has not yet been studied for inter-rater reliability, it has certainly been adequately described and endorsed by its proponents including Maigne[6] and Gillet[22]. Throughout the experiment, each examiner was blinded as to the findings of the other examiner.

The data on levels of skin rolling tenderness and joint play fixation were analyzed for concordance using the Kappa statistic. Kappa (K) values were calculated for exact level agreement and agreement within one level above or below. At each level from T1–T10 the presence of a positive skin roll was assumed to agree with a positive joint challenge if the the joint challenge fixation occurred at the same spinal level, the spinal segment above, or the segment below the positive skin roll.

A separate analysis was conducted to compare pressure algometer threshold readings at the point of a tender skin roll to the algometer reading taken at a level with a non-tender skin roll (control threshold point). For each individual patient, all algometer readings at levels of tender skin roll were used to give a mean value. For each patient the mean value of control points was also determined (see Table 1). These values were then used to conduct a paired t-test with $p < 0.05$.

Results

When a tender skin roll was used as an indication of spinal fixation at the same spinal level as determined by the joint challenge technique, the level of agreement (true positives and true negatives combined) was 67%. The K value was 0.164 [n = 250 (10 spinal levels on each of 25 patients)]. When the spinal level of fixation as determined by joint challenge was expanded to one level above and level below a tender skin roll level, level of true agreement rose to 77%. (See Appendix 1) The K value increased to 0.48 (n = 250). This was significant at the .001 level.

For each individual patient, the mean algometer reading at the positive skin roll areas was compared to the control paraspinal areas mean algometer reading (Table 1). In all 25 subjects with the exception of one, the control threshold point for pain was higher than the threshold for pain at the level of a positive skin roll. For the one exception, the control point and tender skin point had equal algometer readings.

The values for a tender skin roll for all subjects were combined to give an overall mean value. This was repeated for the non-tender skin roll points. The overall mean value of the algometer readings at the location of a tender skin roll for the patient pool was 11.5 lbs., while the mean of the control points was 15.1 lbs., a 23.9% difference favouring decreased threshold to pain-producing pressure at the level of a tender skin roll when compared to a paraspinal area of a non-tender skin roll. The paired t-test analysis of the algometer results indicated a highly statistically significant difference ($p < 0.0005$).

Discussion

The small Kappa value of the first comparison appears to indicate that when exact level agreement is used, there is poor agreement between the skin roll technique and the joint challenge method. However, the second Kappa value (K = 0.48) relating a tender skin roll to a fixation at, above, or below the spinous level indicates a moderate correlation between skin roll tenderness and fixation. There is, therefore modest support for accepting hypothesis 1. This is especially so, given that the cutaneous branches of a spinal nerve do not exit directly at the surface at the spinal level of origin and there is extensive overlap of adjacent dermatomes in the posterior vertebral region. Maigne[8] postulates that in the upper dorsal spine the posterior branches of the spinal nerves traverse the paravertebral groove by three or four spinal segments before becoming superficial. An example is that the T2 posterior branch emerges superficially at the level of the T5 which can imitate the tenderness of the corresponding articular structure. As well, the acceptance of a match plus/minus one segment (which has been reported previously by DeBoer *et al.*[26] and Nansel *et al.*[27]) reproduces the maximum permissible "window" of agreement of segmental levels identified by two independent examiners which still retains the anatomical fidelity required for such an experiment. Since one vertebral level is a component of two contiguous motion segments, then a complex of three levels/two motion segments, is the minimum denotable unit in such a study. The fixation is still contained within that unit, so any of the three vertebral levels serves to designate its presence.

While this will necessarily increase the chance that a match will be found between the levels identified by the two examiners, and while this, alone will increase the Kappa value, we feel that a trade-off is justified. This is analogous to the setting of alpha and beta limits which are set in an experiment in order to contain the element of chance agreement. In this case, exact segment agreement increases (we believe unacceptably) the chance of a false-negative error (type B), while the ± 1 segment "window" offers an acceptable (and clinically justifiable) limit on false positives (type A error).

The latter Kappa value ($K = 0.48$) suggests that dorsal spine skin roll tenderness is a moderately good indicator of the presence of contiguous joint fixation, although a poorer indicator of the exact level of fixation. As such, by demonstrating a moderately high correlation between independently measured aspects of spinal dysfunction (i.e. fixation and tenderness) the validity of the "fixation" concept is given further support, even in the absence of data relative to inter-rater reliability of palpation for same. In some sense, this may be even more important, in that, while raters may agree quite highly on the presence of certain findings, if these findings are unrelated to any other clinically important parameters (such as skin tenderness) then the whole question of reliability is moot. We suggest that dorsal skin roll tenderness be used as a screening procedure to indicate that a dorsal joint fixation may be present within a few spinal segments. The high level of agreement between skin rolling findings and the pressure algometer findings, allows us to accept hypothesis 2 and indicates that the skin roll technique provides an accurate indication of local areas of decreased pain threshold along the dorsal spine.

Future studies in this area might distinguish between acute and chronic patients. As well, further exploration as to the sidedness of these two phenomena and the degree of consistency therein would be useful.

TABLE 1

SUBJECT NUMBER	AVERAGE OF ALGOMETER READINGS AT LOCATIONS OF TENDER SKIN ROLL (lbs.)	AVERAGE OF ALGOMETER READING AT CONTROLS (NON-TENDER SKIN ROLL) (lbs.)
1	10.0	15.0
2	11.9	13.5
3	12.0	11.0
4	18.0	18.0
5	12.5	15.0
6	12.1	17.8
7	7.6	11.5
8	10.8	13.0
9	14.0	18.0
10	9.8	15.3
11	12.2	16.1
12	6.8	8.1
13	11.5	16.5
14	9.7	15.0
15	9.0	14.5
16	8.0	10.5
17	13.0	13.0
18	11.7	17.5
19	12.5	18.5
20	20.0	24.0
21	13.7	16.2
22	10.6	12.1
23	10.0	17.3
24	9.2	14.6
25	10.6	14.4
	$\bar{X}1 = 11.5$	$\bar{X}2 = 15.1$
	$p < .0005$	

Conclusion

The investigators found that a correlation between tender skin roll areas and spinal joint dysfunction (fixations) does exist. This study also revealed that subjects who experienced tenderness in areas of their thoracic spine during the skin roll demonstrated a statistically significant difference between these areas of non-tender skin roll.

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APPENDIX 1: Two by two contingency tables.

FIXATION

		+	−
SKIN ROLL	+	26	38
	−	44	142

EXACT AGREEMENT

FIXATION

		+	−
SKIN ROLL	+	49	16
	−	43	142

± 1 SEGMENT