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Positional changes in distance to the pleura and in muscle thickness for dry needling

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Abstract

Objective This study was conducted to measure and to determine differences in tissue depth in the upper back for two prone positions and to stratify the results by body composition and sex of the patient. In addition, muscle thickness changes with positioning were assessed. This information is important for clinicians who dry needle in the thorax area, cognizant of the dangers of inadvertently piercing the pleura or lung tissue.
Design Descriptive cross-sectional.
Setting Health and Human Performance laboratory at a university campus.
Participants Sample of convenience of 60 college-aged subjects, 20 subjects in three body composition groups.
Main outcome measures Distances from skin to lung tissue, skin to ribs and muscle thickness were measured and compared between two prone positions.
Results There was a significant increase in depth to the lung tissue (0.7 cm, 95% confidence interval 0.4–1.0 cm) when using a bolster under the shoulder. There were also differences in depths between body composition classifications and between sexes, but not between sides. The average thickness of all muscles increased significantly by up to 0.4 cm (95% confidence interval 0.3–0.5) when the shoulder was positioned in retraction.
Conclusions Positioning, body constitution and sex of the patient change tissue depth significantly and should be considered when dry needling. This change is largely attributed to a modification in muscle thickness.

Keywords: DN; Pneumothorax; Haemothorax; Lung; Tissue depth

Introduction

Dry Needling (DN) is a skilled intervention that uses solid filiform needles inserted into myfascial trigger points or other tissues underneath the skin [1]. A trigger point is “a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is tender when pressed and can give rise to characteristic referred pain, motor dysfunction, and autonomic phenomena” [2]. The aim of DN is to treat neuromusculoskeletal pain and reduce movement impairments [1]. While used for decades, DN has only become very popular as an adjunct approach in orthopedic and sports physiotherapy in recent years. As the target tissue for DN includes scar tissue, fascia and connective tissues [1], it can be performed almost anywhere in the body. One of these areas, the thorax, poses a special concern to the practitioner and patient alike, because of its proximity to the lung tissue (Fig. 1). Traumatic pneumothorax and haemothorax are well recognized, but rare iatrogenic complications of acupuncture and dry needling over the thorax [3,4]. They occur when the needle is advanced too deep into the tissue, puncturing the pleura and/or the lung. The piercing allows for air or blood to enter the pleural space. This leads to the uncoupling of the lung from the chest wall, potentially ending in the collapse of the lung, thus limiting the ability to breathe. Popular muscles in the thorax area that receive DN

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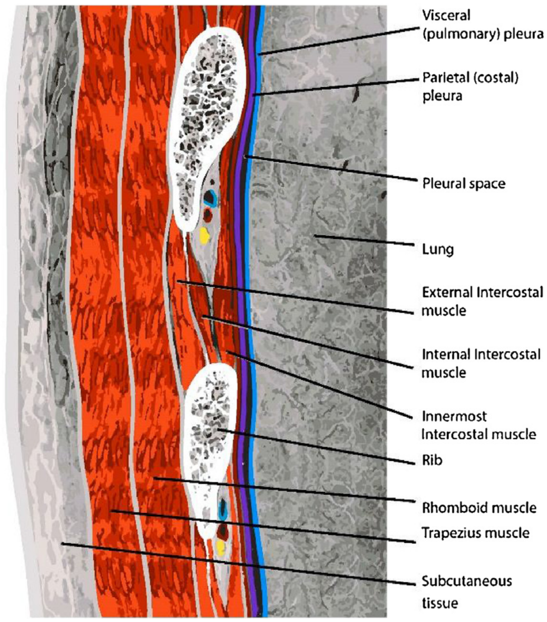

Fig. 1. Longitudinal section through the lateral thoracic wall.
An illustration of the muscle layers in the upper back: the trapezius muscle overlies the rhomboid (major or minor) muscle, which in turn cover the intercostal muscles.

treatment are the rhomboid major and minor, levator scapulae and the upper trapezius muscles [5]. Often ribs are used as 'bony backdrop' when dry needling certain muscles, such as the iliocostalis [4]. To create this bony backdrop a technique called 'blocking' of the rib is used. This is done by covering the intercostal space on either side of the rib with a finger, leaving the space in-between available to perform dry needling. One well-documented case report [4] describes the occurrence of a pneumothorax during a teaching seminar, when a dry needling expert with more than 45 years of practice and teaching advanced the needle past the rib while trying to use the rib as a bony backdrop.

Practitioners who undergo DN training have to demonstrate in-depth knowledge of the anatomy. Technique-related skills that are crucial to minimize the danger of inflicting harm are taught during training sessions, such as proper needle placement, needle direction and angle of needle advancement. Different techniques are utilized in the dry needling of the upper thoracic muscles. For example, as mentioned earlier, one popular approach is the blocking or bracketing of the intercostal space with the interposed rib as backdrop. Another approach is to needle the muscle in a pincer palpation and advance the needle transversely and shallowly into the muscle tissue, in an attempt to avoid deeper structures, such as the pleura or lung. However, there are some patient-related aspects of DN that come with experience, such as knowing how the depth and the thickness of the target muscle tissue change with different positioning, body constitution and sex of the subject. Current clinical practice often utilizes a bolster underneath the shoulder in order to position the scapula in retraction, thus facilitating accessibility of the target tissue.

The primary objective of this non-invasive descriptive cross sectional study was to assess the impact of a bolster underneath the shoulder in the prone position on the distance between skin and lung and skin and rib cage in the upper back. In addition, we assessed if laterality (dominant vs nondominant hand), body composition (as measured by BMI) and sex of the subject affected tissue depth. The secondary objective was to elucidate the potential contribution of muscle thickness to the overall change in distance from skin to pleura. It is our hope that the results of this study can be utilized by practitioners regardless of their preferred dry needling technique.

Methods

Subjects

We used a sample of convenience of 60 subjects, 20 subjects in each of the three BMI groups (BMI 18.5 to 24.9; normal weight, BMI 25 to 29.9; overweight, and BMI of 30 or greater; obese [6,7]). Our study's sample-size was based on a previous study by Seol *et al.* [5], that investigated appropriate depth of needle insertion during trigger point block with the subjects in the sitting position. Specifically, we used their mean depth difference from skin to rhomboid major of 0.2 cm, a standard deviation of 0.2 and the mean depth difference from skin to rib of 0.6 cm with a standard deviation of 0.5, an alpha of 0.05 and a power of 0.8. The analyses suggested we needed at least 16 and 11 subjects per group; we chose to recruit 20 subjects per group. Recruiting was done by distributing flyers on campus and by advertising in classes.

Exclusion criteria consisted of any open wounds in the back or shoulder area and inability to lie prone for 20 minutes. Prospective subjects were screened for exclusion criteria and, if found eligible to participate in this study, were subsequently scheduled for a 30-minute appointment in our laboratory. All the procedures were explained to the participants before written informed consent was obtained.

Data collection

This study was approved by the institutional review board and the rights of the subjects were protected. The subjects gave information on age and handedness, their weight and height measurements were recorded. All ultrasound images were captured using the GE Logiq P6 (GE Healthcare, Wauwatosa, WI, USA), with a 6 to 15 MHz multi linear array transducer or a 5 MHz curvilinear transducer, based on the depth of the target tissues to be visualized. The subject lay prone on a treatment table with the head slightly lowered and the arms positioned along the trunk (Fig. 2) during the scanning. A pillow was placed under the lower legs to improve the subject's comfort. The spinous processes of T1, T2 and T5 were marked, as were the vertebral borders, inferior angles

Table 1
Subject demographics, means.

Subject	N	Age years (SD)	Height cm (SD)	Weight kg (SD)	BMI (SD)
Men	47	26 (5)	184 (6)	98 (21)	29 (5)
Women	13	23 (3)	171 (7)	67 (10)	23 (3)
All	60	26 (3)	181 (8)	91 (23)	28 (6)

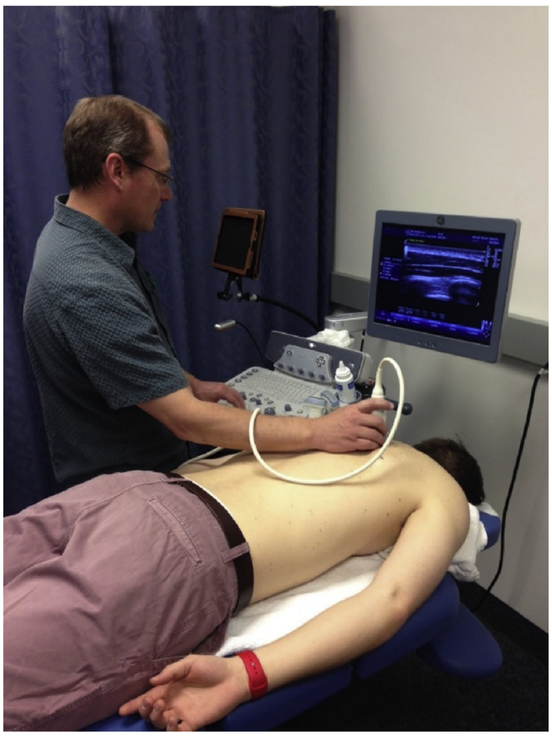

Fig. 2. Subject positioning during ultrasound data collection.
The subject in in prone position, shoulder slightly retracted by bolster.

Fig. 3. Soundhead placement for levator scapulae/trapezius, shoulder positioned on bolster.
The ultrasound transducer was placed longitudinally, medial to the scapula's vertebral border and just superior to the spine of the scapula.

and spines of both scapulae to facilitate accurate locating of target structures.

The two prone positions varied only by the placement of the bolster under the shoulder (Fig. 3). The diameter of the bolster was 7 cm, but we increased its size for larger subjects by an average of 2 cm to retract their scapula.

A trained individual with over 9 years of sonography experience captured the ultrasound images. The first ultrasound measurement performed was on the right lateral triceps in order to obtain a measurement of subcutaneous fat tissue to use as covariate for data analysis. All other ultrasound measurements were recorded in a randomized order for position (subject prone without and with bolster under the shoulder), and laterality (dominant and nondominant side), but in a set order for specific target tissues. We measured the distance from skin to lung tissue and muscle thickness at three sites, in this order: (1) the upper trapezius/levator scapulae, (2) rhomboid minor and (3) rhomboid major levels. The ultrasound transducer was placed longitudinally, medial to the scapula's vertebral border, just superior to the spine of the scapula in order to visualize the lower descending part and upper transverse part of the trapezius and the underlying levator scapulae (Fig. 3). The sound head was then positioned slightly more caudally, while maintaining the longitudinal orientation of the sound head, in order to visualize the ribs and pleura deep to the rhomboid minor. Next, we visualized the ribs and pleura deep to the rhomboid major in the area of ribs 5 and 6, just medial to the vertebral border of the scapula, with the sound head in the same orientation (Fig. 4). For all three sites, the sound head was placed onto the skin, using minimal pressure, in order to produce the most accurate anatomical representation. Each subject was asked to continue to breathe normally while a 4-second ultrasound video was taken. This procedure was repeated twice for each location and in both test positions. These video recordings were stored for later analysis. The investigator measuring the tissue depth was blinded to the subject and to his/her other data in order to reduce measuring bias. Measurements were performed using the ultrasound machine's internal software, which enabled viewing of the recorded video clip. The position of maximum inhalation was chosen to capture a still image, from which measurements were taken. The short-

Table 2
Reliability statistics.

	Intraclass-correlation coefficient	Standard error of the measurement (cm)	Bland–Altman plot: mean difference (cm)	Bland–Altman plot: limits of agreement (cm)	Bland–Altman plot: one-way t-test *P*-value	Bland–Altman plot: regression proportionality *P*-value
Depth	0.997	0.04	−0.002	0.1156 to −0.1196	0.58	0.71
Muscle thickness	0.985	0.03	−0.01	0.1272 to −0.1472	0.25	0.25

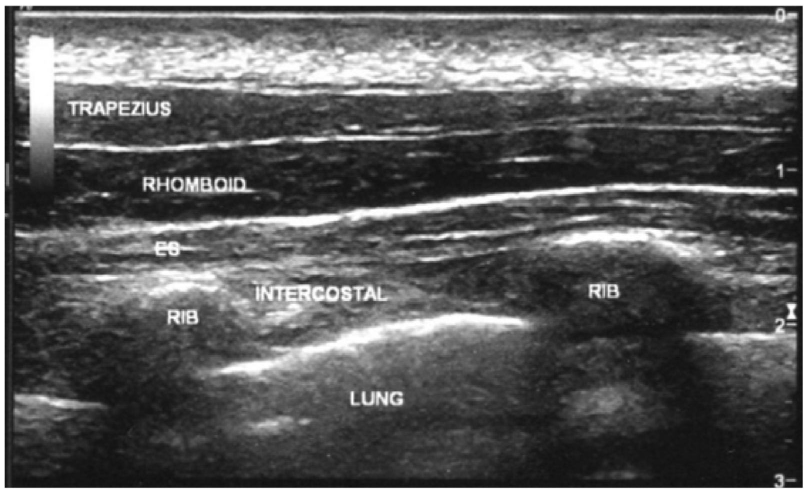

Fig. 4. Longitudinal view of posterior chest wall at the level of ribs 5 and 6. ES: erector spinae muscle.

est linear distance from the skin to the rib and pleura were assessed and recorded. The linear distance between the two fascial layers of the target muscle at a location mid-way between the two ribs was measured. Two measurements were then averaged to obtain the measurement used in the statistical analysis.

Statistical analyses

We used SPSS version 24 (SPSS, IBM Corporation, NY, USA) for all statistical analyses. To assess if the tissue depths were different between dominant and non-dominant sides, we performed paired t-tests for each site and each position. A Bonferroni-corrected alpha of 0.017 was used for the paired t-test comparisons. To determine if positioning (with and without bolster) had an impact on the distance to the structures of interest (at three sites in the upper back), we used General-linear ANOVA with an alpha of 0.05. To determine if belonging to a certain weight category (normal, overweight and obese) had an effect on the distance, we also used a General-linear ANOVA, but used subcutaneous triceps thickness of the right triceps as covariate. To determine if the sex of the subject had an impact on the tissue depth we also used a General-linear ANOVA. Intra-class correlation coefficients (3,K) for the reliability of our ultrasound measurements were computed. Muscle thickness comparisons were made using paired t-tests, a Bonferroni correction was utilized.

Results

Sixty subjects volunteered and qualified for this study; all subjects finished data collection. See Table 1 for demographics. One subject fell into the 'underweight' BMI classification, so we added his data to the 'normal weight' group.

The repeat reliability of the measurements was excellent (Intraclass Correlation Coefficient (ICC) of 0.99), see Table 2. There were no differences between the distances from the skin to the pleura, first rib and second rib on the dominant vs non-dominant side, at any site, for either position (*P*-values between 0.89 and 0.37). The differences between dominant and non-dominant sides ranged between 0.01 and 0.1 cm for the levator scapulae, 0.01 and 0.1 cm for the rhomboid minor and 0.04 and 0.1 cm for the rhomboid major. Therefore, we collapsed the individual target tissue data of both sides into one variable (see Table 3 for means and standard deviations of collapsed data).

A bolster placed under the shoulder significantly increased the distance between skin and pleura on average (for all subjects and all muscles, see Table 3) by 0.7 cm (SD 0.1) ($P < 0.001$). Specifically, the measurements taken at the sites of upper trapezius/levator scapulae, rhomboid minor and rhomboid major increased by 0.7, 0.7 and 0.6 cm respectively. The distances to the corresponding ribs significantly increased in a similar manner (Table 3). On average the ribs were 1 cm thick; the position of the shoulder did, as expected, not make a difference on the thickness of the rib.

Table 3
Average distances of all subjects, right and left sides combined.

Site		Distance in cm (SD)		Difference*	Confidence interval	*P*-value*
		No bolster	With bolster			
Levator scapulae						
	Skin–lung	4.4 (1.0)	5.1 (1.3)	0.7	0.4 to 0.9	<0.001
	Skin–rib 1	3.6 (0.9)	4.2 (1.2)	0.6	0.4 to 0.8	<0.001
	Skin–rib 2	3.2 (0.9)	3.8 (1.1)	0.7	0.5 to 0.9	<0.001
Rhomboid minor						
	Skin–lung	4.0 (1.0)	4.7 (1.3)	0.7	0.5 to 0.9	<0.001
	Skin–rib 1	3.1 (1.0)	3.8 (1.2)	0.7	0.5 to 0.9	<0.001
	Skin–rib 2	2.7 (0.9)	3.5 (1.1)	0.8	0.6 to 1.0	<0.001
Rhomboid major						
	Skin–lung	3.0 (0.8)	3.7 (1.2)	0.6	0.4 to 0.8	<0.001
	Skin–rib 5	2.2 (0.7)	2.9 (1.0)	0.7	0.5 to 0.9	<0.001
	Skin–rib 6	2.0 (0.8)	2.6 (1.0)	0.7	0.5 to 0.9	<0.001

* There is a significant difference in distance to the lung and ribs between positions (no bolster and with bolster) for all three sites.

Table 4
Stratification by BMI.

Site	BMI	Distance in cm (SD)					
		No bolster*			With bolster*		
		20 to 24.9‡	25 to 29.9	>30‡	20 to 24.9†	25 to 29.9†	>30†
Levator scapulae							
	Skin–lung	3.6 (0.6)	4.4 (0.9)	5.2 (0.8)	4.1 (0.6)	5.0 (1.0)	6.1 (1.2)
	Skin–rib 1	2.9 (0.6)	3.5 (0.7)	4.3 (0.8)	3.3 (0.6)	4.1 (0.8)	5.1 (1.1)
	Skin–rib 2	2.5 (0.5)	3.1 (0.8)	3.9 (0.8)	3.0 (0.6)	3.8 (0.8)	4.7 (1.1)
Rhomboid minor							
	Skin–lung	3.1 (0.5)	3.9 (0.9)	4.8 (0.9)	3.7 (0.6)	4.6 (1.0)	5.7 (1.3)
	Skin–rib 1	2.4 (0.6)	3.1 (0.9)	3.9 (0.9)	3.0 (0.6)	3.7 (1.0)	4.8 (1.3)
	Skin–rib 2	2.1 (0.5)	2.6 (0.7)	3.4 (0.8)	2.8 (0.6)	3.4 (0.9)	4.4 (1.1)
Rhomboid major							
	Skin–lung	2.4 (0.3)	3.0 (0.7)	3.7 (0.7)	2.8 (0.5)	3.6 (0.9)	4.6 (1.2)
	Skin–rib 5	1.7 (0.3)	2.1 (0.7)	2.7 (0.7)	2.2 (0.5)	2.8 (0.9)	3.6 (1.1)
	Skin–rib 6	1.5 (0.3)	1.8 (0.7)	2.6 (0.7)	2.0 (0.5)	2.5 (0.9)	3.4 (1.1)

* There is a significant difference in distance from the skin to the lung and from the skin to the ribs between positions (no bolster and with bolster) for all three BMI groups ($P < 0.017$).
† There is a significant difference in distance from the skin to the lung and from the skin to the ribs between all BMI groups in the 'with bolster' position ($P < 0.017$).
‡ There is a significant difference in distance from the skin to the lung and from the skin to the ribs between the lowest and highest BMI value groups in the 'no bolster' position ($P < 0.017$).

Body composition, as measured by BMI and using the subcutaneous triceps tissue as covariate (Table 4) also significantly changed the distance from skin to lung tissue and corresponding ribs in all areas.

The overall average tissue depth to the lung tissue at all three sites combined was significantly different between men and women without bolster and with bolster (Table 5). Normalizing for anatomical differences, by using the no bolster measurement, the overall differences in distances from skin to pleura and skin to ribs were also significantly different between men and women. Across all sites the average change in tissue depth with the bolster was 0.5 cm (SD 0.08) in women, and 0.8 cm (SD 0.05) for men.

None of the muscles were different in thickness (at alpha of 0.017) between dominant and nondominant sides when measured without bolster, so these variables were collapsed into one. The thickness of all muscles measured increased significantly ($P < 0.001$ for all) when a bolster was placed under the shoulder (Table 6).

Discussion

The primary objective of our study was to measure the distance from skin to pleura and respective ribs at the sites of four muscles in the upper back commonly treated with dry needling techniques, i.e. upper trapezius/levator scapulae, rhomboid minor and rhomboid major.

A bolster placed underneath the shoulder to retract the scapula increased the depth from skin to lung and skin to

Table 5
Stratification by sex.

Site		Distance in cm (SD)			
		No bolster		With bolster	
		Men	Women*	Men	Women*
Levator scapulae					
	Skin–lung	4.7 (0.9)	3.4 (0.5)	5.4 (1.2)	3.8 (0.4)
	Skin–rib 1	3.8 (0.8)	2.7 (0.5)	4.5 (1.1)	3.0 (0.5)
	Skin–rib 2	3.4 (0.8)	2.3 (0.4)	4.1 (1.0)	2.7 (0.5)
Rhomboid minor					
	Skin–lung	4.2 (1.0)	2.9 (0.5)	5.0 (1.2)	3.3 (0.5)
	Skin–rib 1	3.4 (1.0)	2.2 (0.5)	4.2 (1.2)	2.7 (0.5)
	Skin–rib 2	2.9 (0.9)	1.9 (0.5)	3.8 (1.1)	2.5 (0.6)
Rhomboid major					
	Skin–lung	3.2 (0.8)	2.2 (0.4)	4.0 (1.1)	2.6 (0.5)
	Skin–rib 5	2.3 (0.7)	1.6 (0.4)	3.1 (1.0)	2.1 (0.5)
	Skin–rib 6	2.1 (0.8)	1.4 (0.4)	2.9 (1.1)	1.9 (0.5)

* There is a significant difference between men and women in the average distance from the skin to the lung and from the skin to the ribs at all locations and both positions (no bolster, P-value = 0.008, and with bolster, P-value >0.001).

Table 6
Change in muscle thickness, in cm (SD).

Muscle	Without bolster	With bolster	Difference	Confidence interval	P-value
Trapezius	1.1 (0.3)	1.2 (0.4)	0.1	0.1 to 0.2	<0.001
Levator scapulae	0.9 (0.3)	1.2 (0.5)	0.3	0.2 to 0.4	<0.001
Rhomboid minor	0.8 (0.3)	1.2 (0.5)	0.4	0.3 to 0.5	<0.001
Rhomboid major	0.6 (0.3)	0.8 (0.5)	0.3	0.2 to 0.4	<0.001

ribs by an average of 0.7 cm. A recent study [5] assessed "safe and appropriate" depth of needle insertion for trigger point injection into the rhomboid major muscle in 62 patients. Ultrasound measurements were taken with the subjects seated, the arm adducted in front of the body and the scapula protracted. The findings indicated that the average distance from skin to muscle was 1.4 cm (SD 0.4) for the men and 1.5 cm (SD 0.3) for the women and that the distance was significantly different between BMI groups, but not between sexes. While the sitting position might be the appropriate position for trigger point injection, the prone position seems intuitively more stable and thus safer for dry needling, specifically when using pistoning techniques. Pistoning is the repeated and rapid inserting and withdrawing of the needle into the trigger point [8]. Additionally, the prone position is a safer position for subjects should they encounter a syncopal response [9]. Our study did not measure the distance to the muscle, but rather to the lung tissue and ribs, therefore, comparisons of data between these two studies are not possible.

Our study is not meant to provide data on safe needle insertion ranges when dry needling the upper back. Instead, it is meant to shed light on the considerable differences positioning can have on the depth of lung tissue and ribs. Our data may guide clinicians in concert with their dry needling specific training and clinical experience in determining the most appropriate treatment practices when attempting to dry needle symptomatic muscles in the thoracic region.

Reference values are given for all subjects (data for right and left sides were collapsed into one variable) for the two different shoulder positions (Table 3), stratified by BMI (Table 4), and stratified by sex (Table 5).

The greater the BMI, the larger the distance from skin to the ribs/thoracic cavity. This statement is true for all three sites we measured. However, the question arises if this finding is equally accurate for a greater BMI that is due to increased muscle bulk as for a greater BMI that is due to increased fat tissue. The calculation of the BMI uses body mass as one of its variables, and therefore it cannot distinguish between fat and lean masses. It is, however, conceivable, that a body with a higher fat percentage has a different target tissue depth than a muscular, lean body. It has been suggested that another means of assessing "fatness", such as triceps skinfold size, might be a more sensitive measure, because it is less biased towards weight [10]. Taking this into consideration, we measured subcutaneous fat in the area of the right triceps in addition to obtaining the BMI. The triceps subcutaneous fat was in fact determined to be a significant variable and thus was used as a co-variate in the analysis.

Within the 'no bolster' position, the only significantly different comparison is that between the lowest and highest BMI group (P = 0.001). Within the 'with bolster' position all three BMI groups are significantly different from each other. All skin to lung distances are significantly different between the two positions for the subjects in the three BMI groups. The differences lie between 0.4 cm for the area of the rhomboid major in subjects with BMI <25 and 0.9 cm for all three muscle sites in subjects with a BMI >30. An interesting finding is that the variability in distances increased with increasing BMI for all measurement sites. We believe that this is a reflection of the heterogeneity of the subjects we used to capture the higher BMI group, i.e. more muscular college athletes and non-athletes with greater body fat percentage [11].

All skin to lung distances are also significantly different between the two positions for both sexes. The smallest difference was 0.4 cm at the site of levator scapulae in the women and the biggest difference was 0.8 cm at the site of the rhomboid minor in men. In addition, we established that the differences in distance between the two positions at the three sites are significantly greater for men compared to women. The average difference in target tissue depth is 0.8 cm for men, and 0.5 cm for women.

We can therefore state, that, regardless of the grouping and stratification, the lung tissue is at a statistically, and we suggest clinically significantly greater depth, when a bolster is placed under the shoulder.

The literature on dry needling, especially on its adverse effects, is still small, albeit exponentially growing [12]. The reviews usually include literature on acupuncture and even diagnostic electromyography because of their use of similar small gauge needles. One study [13] reviewed self-reported adverse effects of more than 229,000 patients after receiving acupuncture. We do not know how many of these acupuncture treatments were performed in the thorax area. Two cases of pneumothorax were reported. They were classified as 'very rare' and the authors indicate that they consider the occurrence of pneumothorax as a sign of negligence or malpractice [13]. A more recent prospective survey [14] reported no significant adverse events in 7629 treatments with dry needling, performed by 39 physiotherapists. When dry needling we must be as cautious as possible to keep the occurrences of adverse effects to an absolute minimum; we suggest that this practice includes proper positioning of the subject. Lastly, we believe that being proactive can play a role in dry needling safety. For example, every patient should be made aware of the risk of pneumothorax and its signs and symptoms. The symptoms of a traumatic pneumothorax can occur immediately [3,15], or within hours [4,16] after needle stick. There should be emergency procedures in place should this complication occur and made known to the patient [15].

The secondary objective of this study was to measure the thickness of the muscles overlying the lung tissue (i.e. levator scapulae, upper trapezius, rhomboid minor and rhomboid major) during two prone positions to show their contributions to the overall distance from skin to lung. We showed a significant increase of muscle thickness in all assessed muscles with positional retraction of the scapula. This muscle thickness increase of up to 0.4 cm contributed considerably to the overall increase in distance between skin to pleura. Knowing this information could have implications for the approximation of appropriate treatment depth and possibly on needling safety.

Key messages

- Distance to pleura and lung and muscle thickness increase with positional retraction of the scapula.
- Reference data on tissue depths and muscle thickness are given.
- Depth of needle insertion needs to be modified and adapted to each patient.

Study limitations

This study included a relatively small sample and subjects of similar ages. In addition, we only had one subject who was classified as 'underweight'. All these factors limit the generalizability of our findings.

Conclusions

Dry needling is becoming more commonplace in orthopedic and sports physiotherapy as its benefits and positive outcomes are realized in the treatment of patients. As its utilization increases, so might the incident rate of adverse effects. Our report is not trying to give specific guidelines on dry needling practice, but it highlights the need for every clinician to consider the changes in tissue depth and muscle thickness that are created with different positioning of the patient. Our findings establish that the depth from skin to lung tissue is greater at the sites of levator scapulae, rhomboid minor and rhomboid major, when a bolster is placed underneath the shoulder so that the scapula is retracted. The thickness of upper back muscles also increases with positional protraction of the scapula. Tissue depths are significantly different between BMI groups and sexes. These factors should be taken under advisement when dry needling.

Ethical approval: The Institutional Review Board of Brigham Young University approved this study (ID# X16119).

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Conflict of interest: The authors declare no conflict of interest. The results of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation.

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