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Abstract

Objectives: To assess the agreements and differences in pain drawings (pain area, shape and location) between individuals who have greater trochanteric pain syndrome (GTPS) and their clinician.

Methods: In this study, 23 patients with GTPS (21 female, pain duration range 8–24 months) underwent clinical evaluation by a registered physiotherapist. Digital 2d full body pain drawings were independently performed by the clinician during the subjective examination and by the patient following the physical examination. Levels of agreement [LoA] in the pain area were assessed with Bland–Altman plots. Differences in pain drawings were assessed visually by overlaying images, and by quantifying the differences in shape and location with the bounding box, and Jaccard index, respectively.

Results: Pain areas (/total pixels of the charts) did not differ in size (LoA mean difference less than −0.5%; range −2.35–1.56%) or shape (bounding box p>0.17). However, there was minimal overlap in location (Jaccard index range 0.09–0.18/1 for perfect overlap).

Conclusions: Patients and the clinician displayed differences in location of pain areas, but not size or shape, when they independently performed digital pain drawings. The reasons that underlie and the clinical impact of these differences remains unclear.

Keywords: digital pain drawings; eHealth; health communication; lateral hip pain; pain assessment.

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Significance: Patient drawings are marginally more extensive than the clinician's, and differences in pain drawings are evident in location but not in the area and shape.

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Introduction

In clinical practice of musculoskeletal pain, clinicians typically record information about the size, shape and location of pain areas described by their patients on a body chart [1–4]. However, there is limited empirical knowledge on how this information is used to guide clinical decision making and patient management.

Pain is an unpleasant sensory and emotional experience associated with, or resembling that association with, actual or potential tissue damage [5]. As pain is influenced by biological, psychological and social factors, there is potential for diversity in how the patient reports the pain experience [6]. Diversity in pain drawings can also be caused by the assessors' perceptions and ability to draw verbal and physical cues on a body chart.

Although digital pain drawings are a commonly used tool, to the authors' knowledge, no scientific evidence exists on *how* pain drawings are used in clinical practice. Notably, from the authors' clinical experiences, not the patient, but the clinician is often the one to complete the pain drawing in clinical practice. This has implications for diagnosis and treatment. Specifically, differences in perceived pain distributions between clinician and patient may cause misinterpretation and miscommunication at the diagnostic and treatment stage [7].

Digital pain drawings have been shown to enable patients and clinicians to analytically understand the location, area and distribution of pain [8]. Digital pain mapping is rapidly evolving and demonstrates good usability, reliability, and repeatability in acute pain [9, 10] and persistent pain conditions of the knee, neck and back [11–13].

To be able to inform and strengthen clinical practice through the use of (digital) pain drawings by clinicians and/or patients, we need to know the similarities and differences in pain drawings between clinicians and patients. A better understanding of the similarities and differences may improve communication, benefit management and improve patient – clinician interaction/experience satisfaction with treatment [9, 14].

Greater trochanteric pain syndrome is one of the most commonly treated tendinopathies in middle-aged, overweight females [15]. It is classically characterised as pain on the lateral side of the hip over the greater trochanter [16]. Some patients also experience pain in the buttocks, lower back and/or distally down the leg [17]. The diverse distribution of pain may reflect different anatomical sources of that pain, that are identified on imaging of greater trochanteric pain syndrome. Alternatively, the diversity in pain distributions may stem from varied pathologies associated with greater trochanteric pain syndrome, such as hip osteoarthritis and referred spinal pain [18–20], central nervous system changes [21, 22], personal characteristics [23, 24], or a combination of these factors. Regardless of the mechanisms underpinning the diversity of clinical presentation, it is important that patients and clinicians can evaluate the distribution of pain in a consistent manner.

To compare patient and clinician representations of pain experienced by individuals who have persistent pain due to greater trochanteric pain syndrome, we explored the agreement between full-body digital pain drawings completed by the patients and a clinician. The specific aims of this study were to (1) assess the agreement between the drawn pain areas, and (2) assess any differences in shape and location of pain drawings. We also collated all pain maps to provide an overall representation of this cohort's pain distribution.

Methods

Study design

This was a cross-sectional study conducted between May 2017 and September 2018 in the Brisbane metropolitan area, as part of a larger cross-sectional study [22]. This study is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies [25]. The study was approved by the University of Queensland Human Research Ethics Committee (#2015000219). All participants provided verbal and written consent after being given information on the purpose of the study.

Setting

All measurements were conducted between May 16, 2017, and September 11, 2018, in a temperature and noise-controlled environment at the Physiotherapy Department of the University of Queensland, Australia.

Participants

Individuals who had lateral hip pain were recruited from the Brisbane metropolitan area with flyers and University advertisements. The sample size could not be calculated *a priori* in a meaningful way, because there is no published data available on pain drawings between patients and clinicians in greater trochanteric pain syndrome. Authors aimed to recruit as many participants as possible in the available timeline (May 2017–September 2018). Eligibility for the study was assessed via online screening (MP), telephone screening interview (MP) and a clinical examination conducted by a registered postgraduate qualified musculoskeletal physiotherapist with >20 years of clinical experience (RM).

Eligibility criteria for individuals who have greater trochanteric pain syndrome (referred to as patients hereon) have previously been described in detail [22] – in summary included: age 18–70 years; lateral hip pain rating ≥2/10 on an 11-point Pain Numeric Rating Scale (PNRS) (0=no pain and 10=worst pain imaginable); pain duration ≥ three months; and pain on palpation of the gluteal tendon insertion on the greater trochanter plus reproduction of trochanteric pain on at least one of six clinical tests [22, 26]. Individuals were excluded if they experienced groin pain, had received a glucocorticoid injection in the last six months, experienced major lower limb trauma in the past year, had any pains that were worse than their hip pain or required treatment for their hip in the past six months. They were also excluded if pain was a result of any other hip joint pathology, if pregnant, or had systemic inflammatory or neurological disorders, uncontrolled diabetes, and fibromyalgia.

Demographic and clinical data were collected using an online questionnaire and included age (years), sex (male/female), and body mass (kg), standing height (cm), duration of symptoms (months), unilateral or bilateral symptoms, the number of pain regions in the past week (recorded with the Nordic Musculoskeletal Questionnaire) [27], average pain in the past week (11-point PNRS), worst pain in the past week (11-point PNRS), pain during activity in the past week (11-point PNRS), and disability with the Victorian Institute of Sports Assessment – gluteal tendinopathy (VISA-G) questionnaire [28].

Acquisition of digital pain drawings

Pain drawings were completed on a 2D digital body chart using the Navigate Pain Android app (Aalborg University, v1). Patients and the clinician drew the area and location of pain on a full-body chart (back, front, left and right) with a Samsung Galaxy Note accessory stylus' pen on a Samsung Galaxy Note 10.1 tablet (Android 4.1.2) with a tip size of 1.5 mm. The digital body charts have been validated against paper drawings in pain-free people [29] and persons with other musculoskeletal pain conditions like patellofemoral pain [3].

All digital pain drawings were made at the time of the clinical examination. Clinician drawings were made during the subjective interview/physical examination, based on the patient's verbal description and by physically indicating their areas of pain by using the finger/s to dynamically outline and delineate the extent of the painful areas on their body. After the clinical examination, and when the clinician had completed their pain drawings, the clinician left the room. Another researcher (MP) replaced the clinician in the room and asked the patient to draw their areas of pain. The patient was not informed about the true objective of the study. Specifically, patients were instructed to "draw one or more areas of current pain on the charts as accurately as possible." The patients and clinician were instructed to completely shade the areas of pain and not to use outlines of the perimeter. Drawings were performed independently.

Outcome measures

Raw data of the digital pain drawings were exported into Microsoft Excel, and the following outcomes were extracted to compute agreement between drawings.

Pain area: The size of the total areas shaded for each view were calculated and expressed in percentage of the total pixels for that view.

Shape: The bounding box was used to portray the *overall shape* of the pain drawing. It was calculated by multiplying the maximum length (y) and width (x) distances of the drawn pain area.

Location: The Jaccard index was used to determine the area of overlap in pain areas between clinician and patient digital pain drawings. It was expressed as a proportion of the total drawn area of both patient and clinician digital pain drawings. This is visualised in Figure S1. The Jaccard index is a number between 0 (no overlap) and 1 (complete overlap) of the patient and clinician drawings. All metrics were automatically extracted from the pain drawings using MATLAB® (Version R2017b, Natick, MA, USA) for the analysis.

Overlay images: Overlay images were used to visually describe and inspect differences in body charts between patients. Overlay images were created by superimposing the original pain drawings of all the patients onto each other. The overlay images show the most frequently reported location of pain using a red colour-scheme, reflecting the original drawing colour, and consists of a linearly increasing pink (frequency of one) to dark brown (highest frequency) as described previously by Boudreau et al. [8]. The colour legend shows the percentage of patients who reported pain in a particular area.

Statistical methods

Results were summarised as means (standard deviations) and median (interquartile range) where appropriate. The level of agreement in the pain area (expressed in percentage of total pixels) was presented through Bland–Altman plots with mean differences and limits of agreement (LoA). Fixed and proportional biases were used to reflect any systematic disagreements between patient and clinician drawings. Fixed bias was represented by the mean of the difference in pixel density from the Bland–Altman plot and proportional bias by a Pearson Correlation Coefficient (PCC) between the difference in pain area and the mean of pain area from the plot (high PCC mean more bias with increased pain area). Pearson correlation coefficients of (negative) 0.0–0.3 were regarded as negligible, 0.3 to 0.5 low, 0.5 to 0.7 moderate, 0.7–0.9 high, and 0.9 to 1.0 very high proportional bias. Differences in the bounding box(x, y) of patient and clinician drawings were compared with a 2-sided paired t-test. The Jaccard index was presented as a mean (95% confidence interval (CI)) and was compared to 0 with a 1-sample t-test to test the null hypothesis of no differences between clinician and patient drawings reflected by a 100% overlap in drawn areas (Jaccard index = 1). All statistics were performed in SPSS (Version 27.0, IBM Statistics, New York). The level of significance was set as $p<0.05$.

Results

Participants

Out of 535 volunteers, 260 underwent telephone screening, 105 underwent clinical examination, and 23 patients with greater trochanteric pain syndrome were included [22]. In total, 23 digital pain drawings were completed by all 23 patients and the clinician. Demographics of our study population can be found in Table 1. Consistent with the greater trochanteric pain syndrome population, the majority of patients were female (n=21). Figure S2 shows examples of individual patient–clinician charts, including charts with minimal differences, charts with large differences, and charts closest to the mean difference in the area.

Table 1: Characteristics of the 23 patients who had greater trochanteric pain syndrome participants. Data represented as mean (Standard Deviation) unless otherwise indicated.

Characteristics	Patients
Age, years	50 (10)
Women n, %	21 (91%)
Body mass, kg/m^2	28.89 (7.37)
Median (Q1–Q3) duration of symptoms months	12 (8–24)
Unilateral n, %	14 (61%)
VISA-G/100	60.36 (9.14)
Median pain severity in past week (Q1–Q3)	
Average PNRS/10	4 (3–5)
Worst PNRS/10	6 (5–7)
During activity PNRS/10	5 (5–8)
Median number of pain regions (Q1–Q3)	2 (2–4.25)

PNRS, pain numeric rating scale; Q1, first quartile; Q3, third quartile.

Similarities in area between pain drawings using Bland–Altman plots

The Bland–Altman plots comparing patient and clinician drawings showed a mean difference between −0.45 and −0.12% of the total pixel counts for all charts. Mean differences (LoA) showed systematic, negative fixed biases for the back (−0.45%; LoA −2.36%, 1.56%), front (−0.32%; LoA −1.08%, 0.44%), left (−0.28%; LoA −2.11%, 1.56%), and right (−0.12%; LoA −1.49%, 1.24%) full body drawings, indicating that clinician pain areas were marginally smaller compared to patients' (Figure 1) [30]. A high proportional bias was found for the front charts (PCC −0.88, $p<0.001$). This indicates that differences between patient–clinician pain drawings for the front charts (e.g., fixed negative biases) increases with larger areas of pain. Low and negligible proportional biases were observed for the left (PCC −0.37), back (PCC −0.11), and right (PCC 0.06) charts (all $p>0.09$). But not for back, left and right charts.

Differences between pain drawings in shape (bounding box) and location (Jaccard index)

Overlays illustrating the pain distribution for the female patients (n=21) and the clinician drawings are shown in Figure 2. Visual inspection of the location and overall pain area suggest minor differences in location and shape of patient and clinician drawings.

No differences in the bounding box(x, y) between participant and clinician drawings were found for any of the chart views (all $p>0.17$, Table 2). The mean Jaccard indexes were 0.09 (95% CI 0.04, 0.16) for the back view, 0.11 (95% CI −0.01, 0.23) for the front, 0.15 (95% CI 0.01, 0.29) for the left and 0.18 (95% CI 0.00, 0.35) for the right view (all $p<0.05$), indicating the overlap of a patient and clinician drawings were very small compared to the sum total of the areas drawn.

Discussion

Our findings suggest differences in *location of pain drawings* reflected by a minimal overlap in patient and clinician drawings based on the Jaccard index, but do not suggest differences in the *area and shape* of the pain drawings reflected by the Bland–Altman plots and bounding box respectively.

Three other studies have reported similarities in patient and clinician pain drawings; two with the Jaccard index [9, 31], and one by categorizing drawn pain areas [32] (see Table S1 for a Table of comparison). The Jaccard index measures the overlap between two drawings (Figure S1), and our study found a mean overlap in drawn areas ranging from 9–18%. To our knowledge, no clinical important difference for the Jaccard index exists, although an overlap between of less than 20% seems very minimal. Two studies that have used the Jaccard index to compare overlap between patient and clinician drawings, finding Jaccard indexes ranging from 19–22% (Table S1) [31]. In our study, lateral images had Jaccard index values of 15–18%, which seem in line with the above studies (Table S1). A minimal overlap could be explained by the clinician being more focussed on the treatment area (in our case the lateral hip), placing the drawing in a slightly different location, and by potentially dismissing other areas of pain that the patient focuses on, which is supported by the individual drawings shown in Figure S2. Jaccard indexes of the back and front full-body charts in our study were much lower (9 and 11%, respectively), which may be explained by the fact that different pain conditions were mapped, that the clinical examination was focused on the assessment of greater trochanteric pain syndrome, and by the timing of the drawings. Another study reported accuracy in pain drawings of 49% between full-body paper drawings of 36 chronic pain patients and their doctor, analysed as drawings being either "same" or "different" [32]. Differences in findings may have been influenced by many factors, including the type of patients (acute pain [9] vs. non-acute/persistent pain [31, 32]), electronic vs. paper drawings, experience in completing pain drawings, the ability to perceive and draw pain, the type of charts and the instructions given to patients and clinicians (Table S1). These factors highlight the

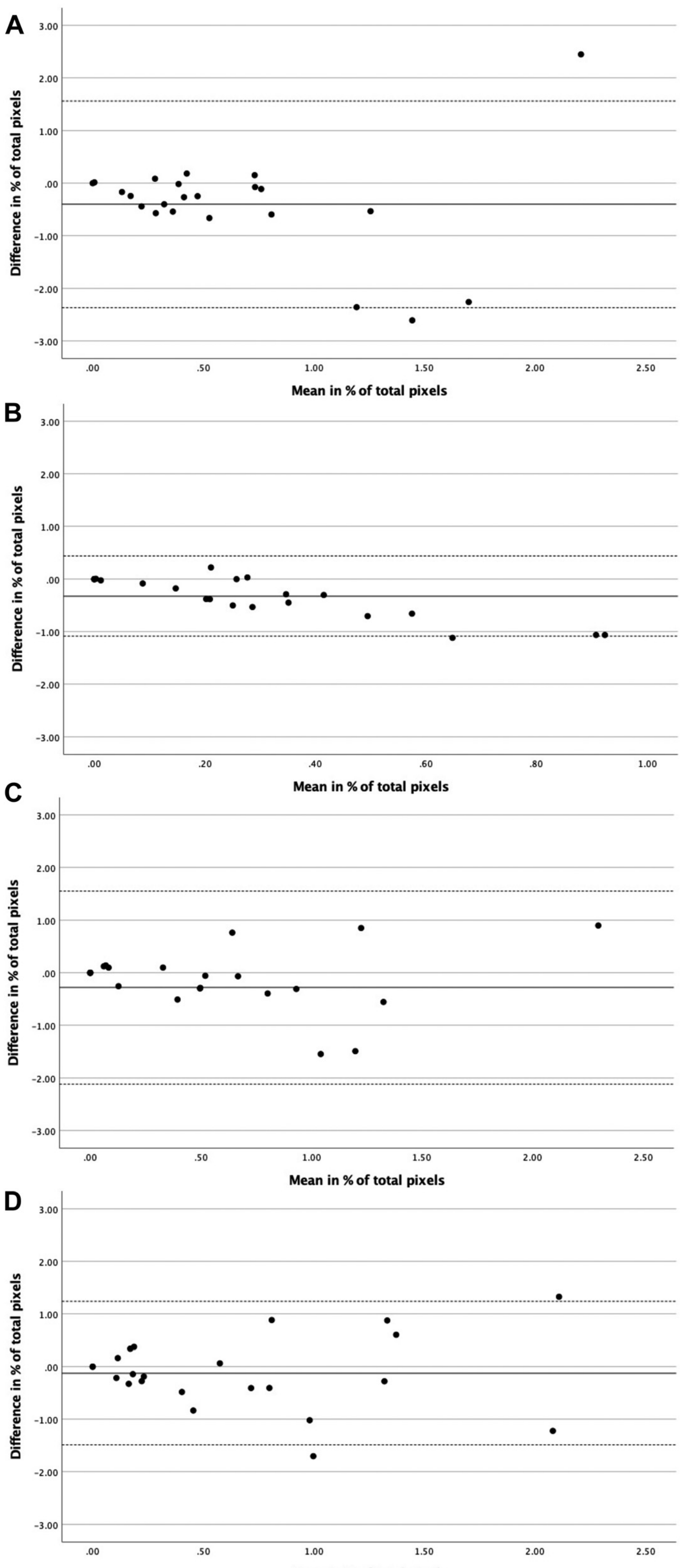

Figure 1: Bland–Altman plots showing the level of agreement in pain area between patient and clinician pain drawings for full-body views of the (A) back, (B) front, (C) left side, (D) right side. The limits of agreement are marked with dashed lines.

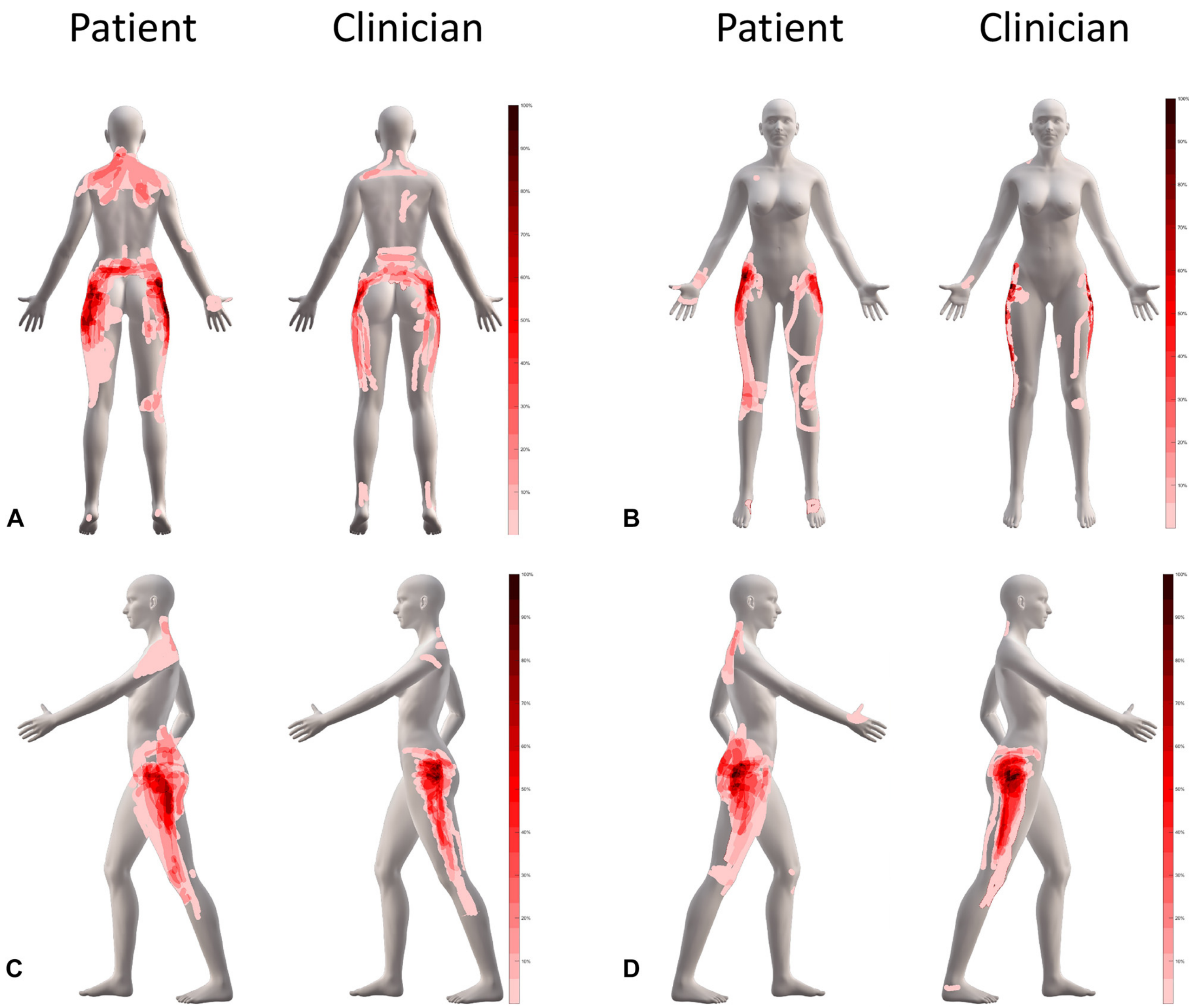

Figure 2: Visual comparison of patient (left column) and clinician (right column) drawings for female full-body charts of (A) the back, (B) front, (C) left and (D) right views (n=21). Men overlay images are presented separately to the females, because the male and female avatars are unique and could thus not be overlayed (Figure S3 for male overlay images).

importance for clinicians and patients to communicate differences and similarities in their pain drawings to ensure information is not lost or changed.

In our study, clinician drawings were, on average, smaller compared to patient drawings. We could speculate that this negative fixed bias could result from patients drawing their current areas of pain, whereas the clinician projected a potential diagnosis. In this study, the bias may have been exaggerated because the clinician made drawings during the clinical examination and the patient did theirs after the clinical examination. The patients plausibly had been cued into their areas of pain after the physical examination as the clinical examination was focussed on stressing (provoking pain) the associated structures involved in greater trochanteric pain syndrome as well as those likely to refer to the hip region. The differences in pain drawings may reflect mis-communication between the patient and clinician, although differences like negative fixed biases (e.g., smaller clinician drawings compared to patient drawings) are to be expected when people perform tasks on unfamiliar devices [33]. In this study, all patients and the clinician were instructed on how to complete the drawing but were unfamiliar with the device and/or application. One study revealed that fixed biases could be overcome by repeated use [33], and therefore future research should incorporate attempts to familiarise patients and clinicians with the device and technology before further investigating these biases.

Table 2: Mean differences (95% confidence intervals), p-value (2-sided paired t-test) in bounding box (BB*x*, *y*) values between patient and clinician drawings (mean [standard deviation]).

Bounding box	Patient	Clinician	Difference
Back view			
BB*x*	144.91 (100.75)	116.48 (96.83)	−28.44 (−70.21, 13.24), 0.17
BB*y*	236.70 (226.20)	222.04 (228.44)	−14.65 (−133.15, 103.84), 0.80
Front view			
BB*x*	110.74 (111.04)	76.48 (97.76)	−24.26 (−85.57, 17.05), 0.18
BB*y*	184.83 (175.81)	123.04 (167.39)	−61.78 (−153.10, 29.53), 0.18
Left view			
BB*x*	68.61 (56.58)	63.65 (46.03)	−4.96 (−24.33, 14.42), 0.60
BB*y*	188.00 (210.77)	137.91 (168.45)	−50.09 (−147.99, 47.82), 0.30
Right view			
BB*x*	81.74 (58.92)	72.35 (49.43)	−9.39 (−37.49, 18.70), 0.50
BB*y*	170.04 (168.39)	152.17 (192.14)	−17.87 (−118.24, 82.50), 0.72

The use of clinician and patient drawings may be a beneficial tool in clinical practice. Shaballout et al. [9] studied pain drawings in an acute pain setting. They had patients and clinicians independently draw the pain on charts and then discussed both drawings during the consultation. This study showed that doctors felt they had improved understanding of the patient's pain and to a lesser extent this impacted on their clinical decisions, even though drawings showed fair to good similarity [9]. An earlier study by Cummings et al. [32] showed that patient drawings alone are insufficient in clinical decision making and that a shared-decision approach to communication between patient and clinician over the pain distributions is desirable [32]. Further, in clinical practice it is often the clinician – not the patient – that completes the pain drawings. Our findings of differences between patient and clinician pain drawings reinforces the notion that at the least, the patient should be making the drawing, and perhaps both the patient and clinician should be completing pain drawings as suggested by Shallabout et al. [7] and Cummings et al. [31]. This may facilitate conversation between clinician and patient and subsequently improve diagnosis and treatment. Further research should examine if allowing the patient and clinician to discuss their pain maps does indeed lead to better clinical decisions and improved care. This approach is supported in other aspects of health care that show detailed communication between patient and clinician about the clinical examination and associated tests (e.g., images, blood tests) will improve quality of care [34].

Strengths, limitations, future research

This study has several limitations that need to be kept in mind when inferring more broadly, they are: (1) the small number of patients (n=23), (2) only one clinician that completed the drawings, (3) a single study site, and (4) patients completed their pain drawing after a full clinical examination whereas the clinician completed their pain drawing during the the examination. The extent to which these factors impact the generalisability of our findings is unknown. To overcome these limitations, future studies would benefit from a larger sample of patients and more than one clinician – providing greater estimates of any biases within our data. Future studies that utilise more extensive data sets of digital pain drawings also provide an opportunity to involve advanced statistical modelling and machine learning methods [29] as clinician support tools during consultations with patients.

Conclusions

Our findings suggest that clinicians and patients will draw somewhat different pain distributions, with differences in location but not in the area or shape of the digital pain drawings. Perceived patient–clinician inconsistencies in the location of pain may influence decision-making and subsequent management, and therefore should be acknowledged and addressed when using (digital) pain drawings in clinical practice. The impact on the decision-making and management of patients remains to be determined.

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Informed consent: Informed consent has been obtained from all individuals included in this study.

Ethical approval: Research involving human subjects complied with all relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration (as amended in 2013) and has been approved by the authors' Institutional Review Board (The University of Queensland Human Research Ethics Committee #2015000219).

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