Original article

Can hip abduction and external rotation discriminate sacroiliac joint pain?

Divya Bharatkumar Adhia a,b,*, Steve Tumilty b, Ramakrishnan Mani b, Stephan Milosavljevic b,1, Melanie D. Bussey a, **

a School of Physical Education, Sport and Exercise Sciences, University of Otago, Dunedin, New Zealand
b School of Physiotherapy, University of Otago, Dunedin, New Zealand

1 Present address: School of Physical Therapy, University of Saskatchewan, Saskatoon, Canada.

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1. Introduction

The sacroiliac joints (SIJ) are well recognised in the literature as a potential source of non-specific low back pain (LBP). The prevalence of SIJ as the source of LBP is reported to range anywhere between 10% (Manchikanti et al., 2001) to 19% (Maigne et al., 1996; DePalma et al., 2011) to 26% (Laslett et al., 2003; Irwin et al., 2007) to 38% (van der Wurff et al., 2006). Although recognized as a potential source of LBP for over 100 years, differentiation and identification of SIJ source and cause of LBP is difficult, resulting in variable treatment outcomes (O’Sullivan, 2005; O’Sullivan and Beasles, 2007).

Several clinical tests have been developed for diagnosing and differentiating pain arising from SIJ (van der Wurff et al., 2000a, 2000b; Cattley et al., 2002; Tong et al., 2006; Hungerford et al., 2007; Stuber, 2007). The criterion of ≥3 positive pain provocation tests is currently considered as the best available and guideline recommended clinical criterion for accurate diagnosis of SIJ pain (Hancock et al., 2007; Laslett, 2008; Szadek et al., 2009). While clusters of pain provocation tests can differentiate patients with SIJ...
source of LBP, the pain provocation tests provide little information about the cause of pain, as pain is not always an indicator of altered biomechanics (Dreyfuss et al., 1996; McGrath, 2010). Several clinicians and authors therefore believe that mobility tests, contrary to pain provocation tests, give at least some information about the quality of SIJ motion and thereby may indicate cause of pain (van der Wurff et al., 2006; Arab et al., 2009; Fryer et al., 2009). The clinical tests that can provide both subjective (i.e., familiar pain reproduction) as well as objective (i.e., SIJ movement characteristics) information about the SIJ, will not only allow clinicians to differentiate and identify individuals with LBP of SIJ origin, but also guide appropriate treatment interventions.

The prone lying incremental Hip Abduction and External Rotation (HABER) test is capable of progressively loading the SIJ through linear increase in innominate rotations (Bussey et al., 2009a). Furthermore, the technique of electromagnetic palpation-digitization technique of pelvic landmarks in the HABER test positions have been used to accurately and reliably measure the innominate movements, in healthy as well as symptomatic populations (Bussey et al., 2009a, 2009b; Adhia et al., 2012; Bussey and Milosavljevic, 2013). More recently, significant differences in the innominate movement patterns have been observed between the individuals with LBP of SIJ origin (SIJ-positive) when compared to individuals with LBP of Non-SIJ origin (SIJ-negative), during the incremental HABER test positions (Adhia et al., 2015). While the palpation-digitization technique in HABER test positions is capable of discriminating objective clinical parameters (i.e., SIJ movement characteristics), the discriminative ability of the incremental HABER test positions to reproduce familiar pain in individuals with symptomatic SIJ is unknown.

Therefore, the primary aim of this study is to determine if the HABER test positions are capable of reproducing familiar pain in clinically diagnosed SIJ-positive LBP individuals when compared with SIJ-negative LBP individuals. If so, the secondary aim is to determine the diagnostic accuracy of HABER test against the reference standard of SIJ pain provocation tests, and to determine which increments of the HABER test have the highest sensitivity and specificity for discriminating SIJ-positive individuals.

2. Method

2.1. Design

The study design is presented graphically in Fig. 1. A laboratory based single-blinded prospective study was conducted in biomechanics laboratory of School of Physical Education, Sport and Exercise Sciences at University of Otago, NZ. Ethical approval for the study was obtained from Human Ethics Committee at University of Otago.

2.2. Participants

One hundred and twenty-two participants, 18–50 years of age, with chronic (≥3 months) non-specific LBP were voluntarily recruited from physiotherapy clinics and wider community; through flyers, advertisement and word of mouth (between August-2012 and June-2013). Participants were excluded due to past or current history of surgery or major trauma to spine, pelvis, lower limb, chest or abdomen in past 12 months; lower extremity musculoskeletal disorders; known localised spinal pathology (viz.,

![Flow diagram of the study design and protocol.](image-url)
tumour, infection, fracture); known congenital anomalies of hip, pelvis or spine that limits mobility; known systemic arthropathy, neuropathy or metabolic disorder; diagnosed acute disc herniation/prolapse with or without radiculopathy; and pregnancy, <6 months post-partum, or post-menopausal women.

The following descriptive information was collected from each participant: demographic information, level of physical activity, level of disability (Modified Oswestry Low Back Pain Disability Questionnaire), duration of pain and current intensity of pain (visual analogue scale (VAS)).

2.3. Reference standard: clinical evaluation

Each participant underwent a standard musculoskeletal clinical examination performed by a qualified manual therapist (MPHTY, PhD) with considerable experience in diagnosing and treating LBP patients (>7 years). The clinical evaluation included a comprehensive set of non-invasive SIJ pain provocation tests recommended in recent literature (Laslett, 2008; Szadek et al., 2009). These included Gaenslen’s test, compression test, distraction test, thigh thrust test, sacral thrust test, and FABER’s test, and were conducted in a randomized order to avoid rater-bias. The categorical responses (familiar pain reproduction or no familiar pain reproduction) to each of these tests were recorded by the clinician and the results were used to classify participants into clinical groups (>3 pain provocation tests positive = SIJ-positive and <3 pain provocation tests positive = SIJ-negative). The reference criterion of >3 positive pain provocation tests has demonstrated high levels of validity (sensitivity 85%, specificity 76%), and diagnostic odds ratio 17.16) (Szadek et al., 2009) and inter-rater reliability kappa 70%) (van der Wurff et al., 2006) for diagnosis of SIJ-positive LBP. In order to account for the side effect (Adhia et al., 2015), the SIJ-positive LBP participants were further divided into three clinical groups, right SIJ-positive (R-SIJ), left SIJ-positive (L-SIJ) and bilateral SIJ-positive (BL-SIJ) LBP, based on the symptomatic side and provocation tests (Fortin et al., 1994a, 1994b, 2003).

2.4. Index test: Hip Abduction-External Rotation (HABER) test

Approximately 20 min following the clinical evaluation, each participant underwent HABER test evaluation by a second musculoskeletal physiotherapist (BPHTY, PhD), blinded to outcome of the reference standard. A hip rotation frame developed by Bussey et al. (2004) was used to standardise the increments of HABER test. The hip of each participant was incrementally (5 x 10° increments) rotated into combined abduction and external rotation simultaneously, and the side (right or left) was randomised. The symptomatic response (i.e. experience of familiar pain) during each increments of the HABER test was documented categorically (familiar pain reproduced or no familiar pain reproduced). The area and intensity of pain (VAS) at baseline and each increment of the HABER test was also documented (Price et al., 1983; Scrimshaw and Maher, 2001; Chapman et al., 2011; Hawker et al., 2011). Familiar pain reproduction was identified in the HABER test if: 1) the participant experienced familiar pain in the area of complain (Laslett et al., 2005; Laslett, 2008), and 2) there was at least a 10 mm increase in intensity of pain when compared with baseline VAS scores (Kelly, 1998; Raftry and Marshall, 2012).

2.5. Data analysis

All statistical analyses were performed using SPSS version 21.0 for Microsoft Windows™. The association between clinical group and pain reproduction in HABER test was determined using a binary logistic mixed model regression analysis (Fitzmaurice et al., 2008; Field, 2009). The familiar pain reproduction in HABER test was defined as the outcome variable and was categorically classified as 0 (No familiar pain reproduction) and 1 (Familiar pain reproduction). The clinical group and HABER test side were defined as independent variables. The clinical group was categorically classified as 0 (Non-SIJ), 1 (R-SIJ), 2 (L-SIJ), and 3 (BL-SIJ). The HABER test side was also categorically classified as 0 (Left) and 1 (Right). The independent variables were defined as fixed effects and participants were defined as random effects. To avoid type-I error and adjust for multiple comparisons, a Bonferroni correction was applied and p value of ≤0.017 was considered as significant. The overall fit of the model was assessed using percentage prediction of the model and the R² value.

To determine the overall diagnostic accuracy of HABER test, a 2 x 2 contingency table was created and the sensitivity, specificity, predictive values and likelihood ratios along with their 95% confidence interval were calculated for each SIJ-positive LBP group (Domholdt, 2005). To determine the HABER incremental positions with highest sensitivity and specificity, a receiver operator curve (ROC) analysis was conducted as a post-hoc, only for those SIJ-positive LBP group (R-SIJ, L-SIJ, BL-SIJ) and for those HABER test side (right or left), that demonstrated significant associations in mixed model regression analysis. The HABER increment (10° or 20° or 30° or 40° or 50°) at which the participant started experiencing familiar pain reproduction was defined as outcome variable and the type of LBP (Non-SIJ, R-SIJ, L-SIJ, BL-SIJ) was defined as test variable. The diagnostic performance of the HABER increments was evaluated by analysing area under the ROC curve (AUC), with values close to 1 indicating better diagnostic power of the test (Park et al., 2004; Fawcett, 2006).

3. Results

The demographic details and clinical characteristics of participants included in each clinical group (SIJ-negative and SIJ-positive) are presented in Table 1.

3.1. Association of clinical group and pain reproduction

The results of binary logistic mixed model regression analysis demonstrated a significant (p < 0.001) association between the clinical group and pain reproduction in the HABER test. Furthermore, the HABER test side (right or left) had a significant effect on the association between clinical group and pain reproduction [clinical group*HABER test side: p = 0.001]. The R-SIJ positive and BL-SIJ positive LBP individuals exhibited pain reproduction in the right HABER test, while the L-SIJ positive and BL-SIJ positive LBP individuals exhibited pain reproduction in the left HABER test; when compared to no pain reproduction exhibited by the Non-SIJ LBP individuals. Table 2 presents the parameter estimates for the interactions between the HABER test side and clinical groups. The model predicted 90% of the pain reproduction responses correctly, and the variables included in the model explained 38% of the variance in pain reproduction in HABER test [R² (0.38)].

3.2. Sensitivity and specificity of the HABER test

Table 3 presents the overall sensitivity, specificity, predictive values and likelihood ratios of the HABER test for pain reproduction in SIJ-positive LBP individuals. The right HABER test displayed moderate levels of sensitivity and specificity for discriminating R-SIJ and BL-SIJ positive LBP individuals, whereas low levels of sensitivity were identified for L-SIJ positive LBP individuals. Similarly, the left HABER test displayed moderate levels of sensitivity
1. Discussion

The present study is the first to evaluate familiar pain reproduction in two groups of non-specific LBP populations during incremental HABER test. The results of the present study demonstrate that the HABER test reproduce familiar pain in clinically diagnosed SJJ-positive LBP individuals when compared to SJJ-negative LBP individuals.

The HABER test demonstrated moderate levels of sensitivity and specificity for diagnosing SJJ-positive LBP individuals. The moderate levels of sensitivity could be attributed to the complex nature of SJJ-pain, with a potential for involvement of multiple intra-articular, as well as extra-articular structures that are all capable of causing SJJ-pain (Vleeming et al., 1996, 2002; Luukkainen et al., 2002; Fortin et al., 2003; Pool-Goudwaard et al., 2003; Cohen, 2005; Kiter et al., 2010; Szadek et al., 2010). The complex anatomical position and orientation of SJJ (Vleeming et al., 2012), precludes any one test from stressing all the SJJ structures that are capable of causing pain, and thereby imposes any one test from being 100% sensitive for diagnosis of SJJ-pain (Dreyfuss et al., 1996; Broadhurst and Bond, 1998; Laslett et al., 2005; van der Wurff et al., 2006). Similarly, while the HABER test can stress some SJJ structures (viz., sacro-tuberous ligament) (Fig. 2) and reproduce familiar pain, it may not stress other SJJ structures (viz., long dorsal sacroiliac ligament (LDSIL) that are also a well-known source of SJJ pain (Vleeming et al., 1996, 2007); thus resulting in a false SJJ-negative LBP diagnosis, thereby leading to a decrease in test sensitivity.

The moderate levels of specificity of HABER test could be attributed to the transmission of forces to other joint areas (Fig. 2). Unlike the Thigh Thrust Test, that has the highest sensitivity and specificity (Ostgaard et al., 1994; Broadhurst and Bond, 1998; Laslett et al., 2005), the HABER test involves no over-pressure or stabilization applied to the sacrum, which could hypothetically help apply greater than anatomical load and direct load straight into innominate through the hip joint. Thus, although HABER test is intended to transmit forces across the loaded SJJ (Bussey et al., 2004, 2009a), the forces may not be restricted to SJJ, but may dissipate to the lumbar-spine through lumbo-sacral junctions. Any pain due to movement restrictions or inflammations in the lumbar spine (especially in lumbo-sacral joints) may also be potentially provoked by the HABER test leading to an increase in the false positive rate and a decrease in the test’s specificity. While this seems plausible, the magnitude of forces transmitted to the lumbar spine is unknown and needs further investigations. Moreover,

Table 1

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>SJJ-negative</th>
<th>SJJ-positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) (Mean ± SD)</td>
<td>30.2 ± 9.8</td>
<td>35.1 ± 10.6</td>
</tr>
<tr>
<td>Sex (Females: Males)</td>
<td>49: 28</td>
<td>12: 6</td>
</tr>
<tr>
<td>Dominance (Right: Left)</td>
<td>65: 12</td>
<td>16: 2</td>
</tr>
<tr>
<td>BMI (kg/m²) (Mean ± SD)</td>
<td>25.0 ± 4.2</td>
<td>27.2 ± 6.8</td>
</tr>
<tr>
<td>Physical activity (hours/week) (Mean ± SD)</td>
<td>9.1 ± 7.0</td>
<td>7.1 ± 5.4</td>
</tr>
<tr>
<td>Pain duration (years) (Mean ± SD)</td>
<td>7.6 ± 11.4</td>
<td>7.1 ± 6.6</td>
</tr>
<tr>
<td>VAS score (mm) (Mean ± SD)</td>
<td>10.8 ± 15.6</td>
<td>10.8 ± 8.1</td>
</tr>
<tr>
<td>Modified Oswestry LBP disability score (%) (Mean ± SD)</td>
<td>12.0 ± 8.8</td>
<td>12.1 ± 8.6</td>
</tr>
</tbody>
</table>

R = right, L = left, BL = bilateral, n = sample size, SD = standard deviation, VAS = visual analogue scale, LBP = low back pain.

Table 2

<table>
<thead>
<tr>
<th>Test side</th>
<th>Clinical group</th>
<th>B</th>
<th>Stand. error</th>
<th>Sig</th>
<th>Exp (B)</th>
<th>95% CI Exp (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right HABER test</td>
<td>R-SJJ</td>
<td>1.78</td>
<td>0.67</td>
<td>0.009*</td>
<td>5.95</td>
<td>1.58 – 22.37</td>
</tr>
<tr>
<td></td>
<td>L-SJJ</td>
<td>0.74</td>
<td>0.87</td>
<td>0.399</td>
<td>2.09</td>
<td>0.59 – 7.63</td>
</tr>
<tr>
<td></td>
<td>BL-SJJ</td>
<td>2.33</td>
<td>0.72</td>
<td>0.001*</td>
<td>10.32</td>
<td>2.51 – 42.41</td>
</tr>
<tr>
<td>Left HABER test</td>
<td>R-SJJ</td>
<td>0.48</td>
<td>0.66</td>
<td>0.143</td>
<td>1.62</td>
<td>0.44 – 5.94</td>
</tr>
<tr>
<td></td>
<td>L-SJJ</td>
<td>1.79</td>
<td>0.91</td>
<td>0.001*</td>
<td>5.96</td>
<td>1.03 – 35.44</td>
</tr>
<tr>
<td></td>
<td>BL-SJJ</td>
<td>2.33</td>
<td>0.72</td>
<td>0.001*</td>
<td>10.32</td>
<td>2.51 – 42.41</td>
</tr>
</tbody>
</table>

* Indicates a significant association with pain reproduction with p < 0.017.

Table 3

<table>
<thead>
<tr>
<th>Test</th>
<th>Clinical group</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
<th>PPV (95% CI)</th>
<th>NPV (95% CI)</th>
<th>PLR (95% CI)</th>
<th>NLR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right HABER test</td>
<td>R-SJJ</td>
<td>0.67 (0.41 – 0.86)</td>
<td>0.72 (0.61 – 0.82)</td>
<td>0.36 (0.21 – 0.55)</td>
<td>0.90 (0.79 – 0.96)</td>
<td>2.44 (1.50 – 3.99)</td>
<td>0.45 (0.24 – 0.89)</td>
</tr>
<tr>
<td></td>
<td>L-SJJ</td>
<td>0.44 (0.15 – 0.77)</td>
<td>0.72 (0.61 – 0.82)</td>
<td>0.16 (0.05 – 0.36)</td>
<td>0.92 (0.81 – 0.97)</td>
<td>1.63 (0.72 – 3.69)</td>
<td>0.76 (0.42 – 1.38)</td>
</tr>
<tr>
<td></td>
<td>BL-SJJ</td>
<td>0.78 (0.52 – 0.93)</td>
<td>0.72 (0.61 – 0.82)</td>
<td>0.40 (0.24 – 0.58)</td>
<td>0.93 (0.83 – 0.98)</td>
<td>2.85 (1.84 – 4.43)</td>
<td>0.30 (0.13 – 0.73)</td>
</tr>
<tr>
<td>Left HABER test</td>
<td>R-SJJ</td>
<td>0.39 (0.18 – 0.64)</td>
<td>0.71 (0.60 – 0.81)</td>
<td>0.24 (0.11 – 0.44)</td>
<td>0.83 (0.71 – 0.91)</td>
<td>1.36 (0.69 – 2.68)</td>
<td>0.86 (0.59 – 1.25)</td>
</tr>
<tr>
<td></td>
<td>L-SJJ</td>
<td>0.67 (0.31 – 0.91)</td>
<td>0.71 (0.60 – 0.81)</td>
<td>0.21 (0.09 – 0.41)</td>
<td>0.95 (0.85 – 0.99)</td>
<td>2.33 (1.30 – 4.17)</td>
<td>0.47 (0.18 – 1.19)</td>
</tr>
<tr>
<td></td>
<td>BL-SJJ</td>
<td>0.78 (0.52 – 0.93)</td>
<td>0.71 (0.60 – 0.81)</td>
<td>0.39 (0.23 – 0.56)</td>
<td>0.93 (0.83 – 0.98)</td>
<td>2.72 (1.78 – 4.19)</td>
<td>0.31 (0.13 – 0.75)</td>
</tr>
</tbody>
</table>

PPV: Positive predictive value, NPV: Negative predictive value, PLR: Positive likelihood ratio, NLR: Negative likelihood ratio, AUC: Area under curve, CI: Confidence interval.
Further research is needed to determine if any modification of HABER test (viz., sacral or lumbo-sacral stabilization) could help improve its sensitivity and specificity for discriminating SIJ-positive LBP.

An alternate explanation for moderate levels of sensitivity and specificity of HABER test could be attributed to methodological limitations in the diagnostic criterion used to identify SIJ-positive LBP individuals. Despite decades of investigations, researchers have not yet reached agreement on a battery of tests or the outcome criterion that should comprise gold standard for diagnosing SIJ pain (Berthelot et al., 2006; McGrath, 2010). For example, McGrath (2010) argues that pain provocation tests predicting SIJ disorder on basis of pain are open to patient-reported bias. Berthelot et al. (2006) claim that double anaesthetic SIJ blocks are an unreliable source of reference standard and lack specificity for accurate diagnosis of SIJ pain. While still controversial, fluoroscopic guided diagnostic SIJ blocks are most commonly used and acceptable gold standards for confirming SIJ-positive LBP diagnosis (Fortin et al., 1994a; Schwarzer et al., 1995; Dreyfuss et al., 1996; Magine et al., 1996; Slipman et al., 1996, 2000, 2001; Broadhurst and Bond, 1998; Manchikanti et al., 2001; Fukui and Nosaka, 2002; Young et al., 2003; Laslett et al., 2003, 2005; Magine and Planchon, 2005; van der Wurff et al., 2006). The present study did not use diagnostic SIJ blocks as reference standard, but a valid and reliable criterion (≥3 positive pain provocation tests) for identifying the SIJ-positive LBP individuals (Laslett et al., 2005; van der Wurff et al., 2006; Laslett, 2008). While this criterion has the highest validity and reliability, it is plausible that some individuals could have been falsely classified as SIJ-positives and SIJ-negatives (Laslett et al., 2005). Further validation of the HABER test positions against the diagnostic SIJ blocks is required.

A further potential methodological limitation may be found in the cut-off criterion for determining pain reproduction in LBP individuals. Several researchers most commonly use experience of familiar pain (with no specific cut-off) as the criteria for defining pain reproduction during the test (Dreyfuss et al., 1996; Laslett et al., 2005). However, the baseline pain in participants may vary, which may likely influence the results of pain reproduction during the provocation test. For instance, some participants may already have considerable baseline pain in neutral position, and it is possible that they may experience pain in test positions, but not necessarily due to test position itself. In order to overcome these factors and to standardise the criteria between participants, the present study used a 10.0 mm increase in VAS scores as the criteria factors and to standardise the criteria between participants, the necessarily due to test position itself. In order to overcome these possible that they may experience pain in test positions, but not the provocation test. For instance, some participants may already this criterion would have affected results of the present study.

Our findings suggests that SIJ-positive individuals experienced pain in end ranges of HABER test with cut-off criterion of ≥30° displaying the highest sensitivity. The high sensitivity of ≥30° HABER test can be attributed to increased levels of stress that hip movement may impose on SIJ with each increment. In several studies (Bussey et al., 2009a, 2009b; Bussey and Milosavljevic, 2013), a linear positive relationship between innominate ranges of motion (transverse & sagittal plane) and increments of HABER test has been demonstrated in healthy controls. The loaded innominate (i.e., right innominate in right HABER test) typically demonstrates an external rotation in transverse plane and a posterior rotation in sagittal plane with each increment of HABER test (Bussey et al., 2009a, 2009b)(Fig. 2). The unloaded innominate (i.e., left innominate in the right HABER test), on the other hand also displays a coupling motion of either an external or internal rotation in transverse plane and an anterior rotation in sagittal plane (Bussey et al., 2009a, 2009b). Any anomalies in the movements of the loaded innominate or the coupling mechanisms of unloaded

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### Table 4

<table>
<thead>
<tr>
<th>Clinical group</th>
<th>Right</th>
<th>Left</th>
<th>Right</th>
<th>Left</th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>HABER test side</td>
<td>R-SIJ</td>
<td>L-SIJ</td>
<td>R-SIJ</td>
<td>L-SIJ</td>
<td>R-SIJ</td>
<td>L-SIJ</td>
</tr>
<tr>
<td>Sensitivity (95% CI)</td>
<td>0.83 (0.51-1.07)</td>
<td>1.00 (0.70-1.00)</td>
<td>0.97 (0.64-0.98)</td>
<td>0.86 (0.56-0.89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specificity (95% CI)</td>
<td>0.52 (0.41-0.64)</td>
<td>0.64 (0.56-0.72)</td>
<td>0.64 (0.57-0.72)</td>
<td>0.51 (0.39-0.65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPV (95% CI)</td>
<td>0.97 (0.86-1.00)</td>
<td>1.00 (0.70-1.00)</td>
<td>0.97 (0.85-0.98)</td>
<td>0.86 (0.56-0.89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV (95% CI)</td>
<td>0.55 (0.33-0.82)</td>
<td>0.60 (0.36-0.82)</td>
<td>0.60 (0.36-0.82)</td>
<td>0.55 (0.33-0.82)</td>
<td></td>
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</tr>
<tr>
<td>AUC (95% CI)</td>
<td>1.80 (1.10-1.20)</td>
<td>2.20 (1.30-1.20)</td>
<td>2.36 (1.30-1.20)</td>
<td>2.10 (1.10-1.20)</td>
<td></td>
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</tbody>
</table>

**Legend:**
- **PPV:** Positive predictive value
- **NPV:** Negative predictive value
- **AUC:** Area under curve
- **CI:** Confidence interval

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*D.B. Adhia et al. / Manual Therapy 21 (2016) 191–197*
innominate are likely to provoke pain in SIJ-positive individuals with each increment of the HABER test. Different innominate coupling patterns have been observed between the SIJ-positive and SIJ-negative LBP individuals, with an apparent change in the coupling after 30° of the HABER test (Adhia et al., 2015). While it is possible that these different innominate coupling trends have a relationship with pain reproduction, it is also difficult to discern if the different innominate coupling trends observed in SIJ-positive LBP individuals are a cause or a result of pain reproduction. Exploration of such relationships is likely to be a component of future investigation with a larger sample of SIJ-positive LBP individuals and a prospective follow up of healthy controls.

The current study provides the musculoskeletal clinicians with a new clinical test for accurate diagnosis of LBP of SIJ origin. The HABER test is capable of reproducing familiar pain in SIJ-positive LBP individuals, and demonstrates acceptable levels of diagnostic accuracy for discriminating LBP of SIJ origin. The HABER increments of >30° displayed highest sensitivity for reproducing familiar pain in SIJ-positive LBP individuals, irrespective of the SIJ-positive LBP group and the HABER test side.

5. Conclusion

The HABER test is capable of reproducing familiar pain in SIJ-positive LBP individuals, and demonstrates acceptable levels of diagnostic accuracy for discriminating LBP of SIJ origin. The HABER test can be considered more likely to have LBP of Non-SIJ origin.

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