Use of Four Predictive Screening Variables for Determination of Sacroiliac Joint Dysfunction in Adolescent Athletes

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ABSTRACT

Chronic onset of sacroiliac joint dysfunction (SIJD) is increasing in the adolescent soccer population. However, there is currently no screening tool in this population that can accurately predict the risk of sustaining SIJD. **PURPOSE**: To create an effective screening tool for SIJD in adolescent soccer athletes and establish predictive values for SIJD injury risk. **METHODS**: 20 participants that were members of the varsity and junior varsity boys' (n = 6, 16.33±1.37 yrs, 176.50±6.98 cm, 72.12±9.92 kg) and girls' (n = 14, 16.00±1.11 yrs, 165.93±6.39 cm, 61.11±6.92 kg) soccer teams from one mid-Atlantic high school completed the study. Each participant performed during one testing session the Functional Movement Screen (FMS), including all 7 functional movements and the 3 clearing tests, active knee extension test (AKET), Palpation Meter (PALM) measurement for pelvic angle, and goniometry assessment of active hip range of motion (ROM) including flexion, extension, abduction, adduction, internal rotation, and external rotation for both limbs. SIJD injury data from the past season and a self-report demographic/injury questionnaire were also used. **RESULTS**: There were 2 significant correlations with a large strength between PALM and active hip extension (PCC =0.732, p<.01) and SIJ injury and active hip abduction (PCC = 0.545, p = .013). A significant correlation with medium strength (PCC = 0.473, p = .035) was found between the AKET and active hip flexion. One model in the binary logistic regression created a best fit with an odds ratio of 1.115 (CI95 = 1.003, 1.239, p = .044) with the variables of SIJ injury and active hip abduction. Two nonsignificant models with moderate odds ratios were produced for the PALM (OR = 1.141, CI95 = .841, 1.547, p = .397) and years playing soccer (OR = 1.319, CI95 = .854, 2.036, p = .212). A stepwise binary logistic regression created a best fit model with an odds ratio of 1.168 (CI95 = 1.004, 1.359, p = .045) that included both active hip abduction and the FMS to detect an SIJ injury. All other results were not significant. **CONCLUSION**: Those with the highest angle of active hip abduction had an increased risk of SIJ injury by 11.5% and when the lowest FMS composite score was included SIJ injury risk increased to 16.8% . Years of playing soccer and pelvic positioning may also be clinically useful assessments.

INTRODUCTION

There is a plethora of research on sacroiliac joint dysfunction (SIJD) and low back pain (LBP) in athletes in the adult population across a wide span of sports. Conversely, there is a lack of knowledge on SIJD in adolescent athletes even though it has become increasingly prevalent in the adolescent population for reasons that are not well understood. (1) With the increase of SIJD incidence in the adolescent population, further studies are warranted in sports that stress the sacroiliac joint (SIJ). One such sport is soccer where high intensity forces are placed on the lower extremities that are often unilaterally dominant. These forces are transferred superiorly to the trunk through the sacrum and SIJ acting as the gateway. The biomechanical demands of playing soccer, including bending and twisting of the trunk and variable lateral movement are a reason for SIJD to occur at such a high rate. (2,3) Thus, with the increase of SIJD incidence in the adolescent population, some type of screening tool must be developed to assess predictive factors of SIJD, especially in soccer athletes. Currently there is no constructed clinical screening tool to assess predictive factors for SIJD in the adolescent soccer athlete population. With no known screening tool available, four different biomechanical and functional components that should be considered are the Functional Movement Screen (FMS), pelvic positioning, hamstring length, and hip ROM.

PURPOSE

To create an effective screening tool for SIJD in adolescent soccer athletes and establish predictive values for SIJD injury risk.

METHODS

- Subjects
- 20 participants from the varsity and junior varsity boys' (n = 6, 16.33±1.37 yrs, 176.50±6.98 cm, 72.12±9.92 kg) and girls' (n = 14, 16.00±1.11 yrs, 165.93±6.39 cm, 61.11±6.92 kg) soccer teams from one high school completed the study.
- This study was approved by the Institutions Office of Research Compliance.

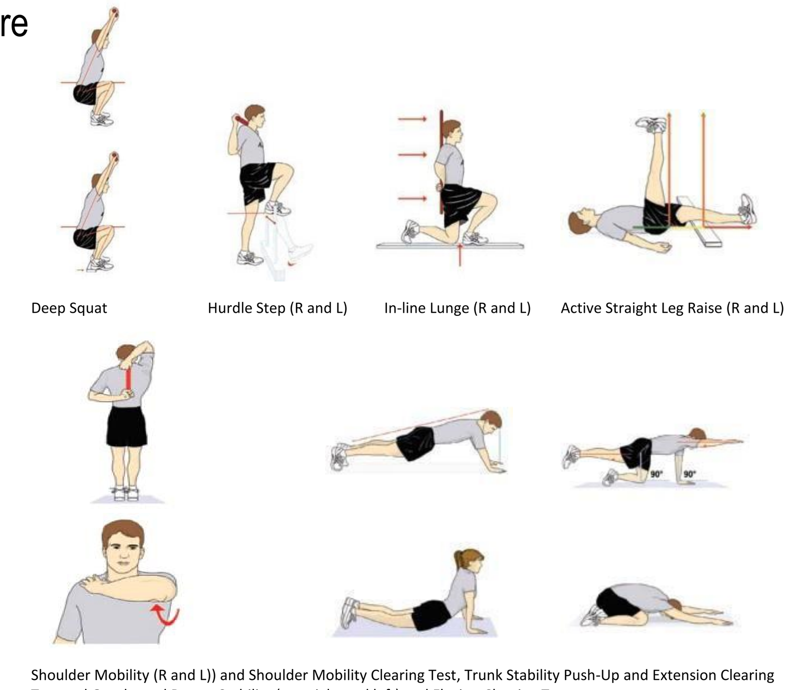
Procedures

- Completion of the Functional Movement Screen (FMS) including 7 functional movements and the 3 clearing tests, assessment of active hip range of motion (ROM) including flexion, extension, abduction, adduction, internal and external rotation for both limbs. active knee extension test (AKET), and Palpation Meter (PALM) measurement for pelvic angle
- All measurements in the screening tool were completed during one testing session. SIJD data from the past season and a self-report demographic/injury questionnaire were also used.

PROCEDURES

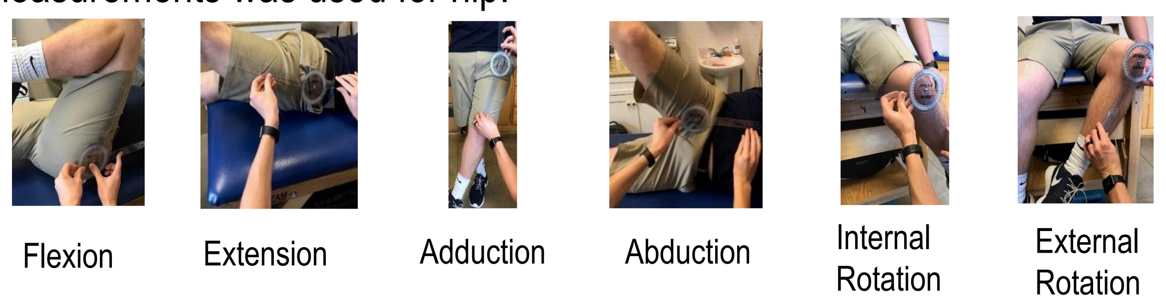
Functional Movement Screen Protocol (4)

- Standard FMS testing procedures were used to perform the 7 fundamental movements and 3 clearing tests.
- A movement was given a score between 0 and 3. A score of 1 indicated the inability to complete the movement, 2 represented compensation while completing the movement, and 3 signified a correct completion of the movement without compensation.
- The final score denoted the overall score for the test. The lowest score for the raw score (each side) was carried over to give a final score for the test. Tests that are scored for both right and left sides, the lower score is used when calculating FMS composite score



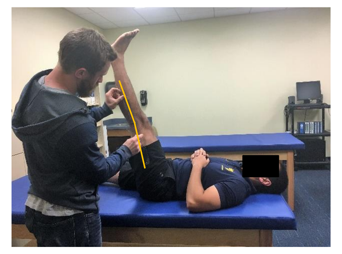
Hip ROM (5)

Using a goniometer for both limbs the average of the 2 measurements was used for hip:



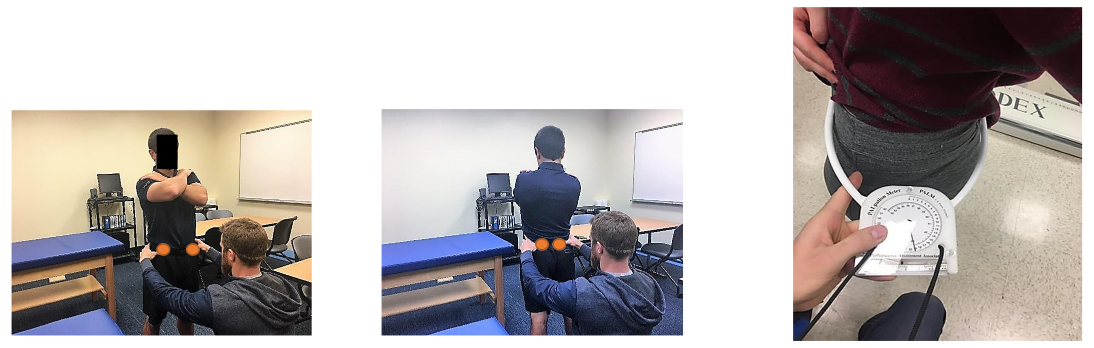
Active Knee Extension Test (AKET) (6)

Angle measurement taken with a goniometer.
Axis along the knee joint and arms aligned along the femur and tibia.



Palpation Meter (PALM) (7,8)

Caliper tips placed over the ASIS and PSIS marked landmarks on the same side and compressed to full resistance. The angle of inclination is read using the average of the 2 measurements.



RESULTS

There were 2 significant correlations with a large strength between PALM and active hip extension (PCC =0.732, p<.01) and SIJ injury and active hip abduction (PCC = 0.545, p = .013).

A significant correlation with medium strength (PCC = 0.473, p = .035) was found between the AKET and active hip flexion.

Table 1. Descriptive Statistics on Means and SD for Screening Variables and SIJ Injury.

Screening Variables	With SIJ Injury	Without SIJ Injury	Normative Value
FMS Comp Score	17.80±1.64	18.6±0.83	≥14
AKET	68.80±9.96	70.78±11.55	54.4(M) 62.9(F) 72.3 – 73.9
PALM	12.35±2.18	10.63±4.34	6.49 (M) 6.78 (F)
HROM Flex	131.64±2.60	126.97±7.34	113(M) 120(F)
HROM Ext	31.10±6.03	32.30±12.29	15(M) 22(F)
HROM Abd	84.90±12.49	65.67±13.77	34(M) 44(F)
HROM Add	41.15±6.84	40.02±7.07	14(M) 17(F)
HROM IR	44.15±6.35	43.65±6.73	35(M) 35(F)
HROM ER	37.15±3.02	36.65±3.83	40(M) 46(F)

Key: FMS Comp Score = Functional Movement Screen Composite Score; AKET = active knee extension test; PALM = palpation meter(pelvic tilt, Positive degrees = anterior tilt); HROM Flex = hip range of motion flexion; HROM Ext = hip range of motion extension; HROM Abd = hip range of motion abduction; HROM Add = hip range of motion adduction; HROM IR = hip range of motion internal rotation; HROM ER = hip range of motion external rotation; M = male; F = female

Table 2. Binary Logistic Regression Model for Screening Variables Associated with the Occurrence of a SIJ Injury

Predictor Variable	Cox and Snell R^2	Nagelkerke R^2	Hosmer Lemeshow Test[a]	Odds Ratio (95% Confidence Interval)	P Value
FMS[b]	.095	.140	.697	.505 (.179, 1.435)	.197
AKET	.006	.009	.691	.983 (.896, 1.079)	.720
PALM	.040	.059	.199	1.141 (.841, 1.547)^	.397
HROM Flex	.104	.154	.285	1.151 (.932, 1.422)	.192
HROM Ext	.002	.004	.571	.990 (.900, 1.087)	.827
HROM Abd	.282	.418	.935	1.115 (1.003, 1.239)	.044*
HROM Add	.005	.008	.583	1.025 (.884, 1.188)	.743
HROM IR	.001	.002	.673	1.012 (.866, 1.184)	.878
HROM ER	.004	.006	.156	1.043 (.776, 1.402)	.781
Years Playing[b]	.113	.167	.381	1.319 (.854, 2.036)^	.212
Currently Active	.059	.088	<0.001	621336498.800 (.000, .000)	>0.999

Key: [a]Hosmer and Lemeshow Test must be insignificant in value for the regression model to be analyzed by SPSS. [b]Regression model correctly predicted one case for the FMS and Years playing variables. *Statistically significant finding. ^Moderate Odds Ratio

Table 3. Stepwise Binary Logistic Regression Model for Screening Variables Associated with SIJ Injury

Model Number	Cox and Snell R^2	Nagelkerke R^2	Hosmer Lemeshow Test[a]	Odds Ratio (95% Confidence Interval)	P Value
1: HROM Abd	.282	.418	.935	1.115 (1.003, 1.239)	.044*
2: HROM Abd and FMS	.426	.631	.873	1.168 (1.004, 1.359)	.045*

Key: [a]Hosmer and Lemeshow Test must be insignificant in value for the regression model to be analyzed my SPSS. *Statistically significant finding. The interaction term between HROM Abd and FMS was not significant.

CONCLUSIONS

- The model of active hip abduction and SIJ injury indicated that those with the highest angle of active hip abduction had an increased risk of an SIJ injury by 11.5%.
- Why an ↑ in hip abduction may be related to the biomechanical alteration that occurs at the sacrum during kicking, running, and lateral movements in soccer.
  - The ↑ in hip abduction also may influence the "force closure" mechanism that is predominantly controlled by the latissimus dorsi, gluteus maximus, and thoracolumbar fascia.(9-12)
  - If the sacrum cannot properly serve as the gateway between the lower extremities and the spinal column, then the forces will remain in the SIJ and result in injury.
- In this model of FMS with active hip abduction, those with the highest angle of active hip abduction, and the lowest FMS composite scores had an increased risk of SIJ injury by 16.8%. These findings suggest that ROM, especially hip abduction, and FMS scores may be an important consideration in deciding which variables to evaluate, as well as to consider for prevention and intervention strategies.
- The ↑ risk of injury suggested that these 2 screening variables are related to each other. The 7 fundamental movements of the FMS are primarily performed in the sagittal plane; however, the subject must be able to maintain stability to not deviate into the frontal or transverse plane.
  - This stability is controlled partly by the gluteus medius, which is the main contributor to hip abduction. The need to activate the gluteus medius during certain functional movements may be why the model's ability to predict an SIJ injury improved with the inclusion of the FMS.
- Currently there is no constructed clinical screening tool to assess predictive factors for SIJD in the adolescent soccer athlete population. Years of playing soccer, the FMS, and pelvic positioning may also be clinically useful assessment measures to predict an SIJ injury.

REFERENCES

1. Anderson GBJ. Epidemiological features of chronic low back pain. *Lancet*. 1999;354:581-5.
2. Noormohammadpour P, Rostami M, Mansournia MA, Farahbakhsh F, Pourgharib Shahi MH, Kordi R. Low back pain status of female university students in relation to different sport activities. *Eur Spine J*. 2016;25(4):1196-203.
3. Van Hilst J, Hilgersom NF, Kuilman MC, Kuijer PP, Frings-dresen MH. Low back pain in young elite field hockey players, football players and speed skaters: Prevalence and risk factors. *J Back Musculoskelet Rehabil*. 2015;28(1):67-73.
4. Cook G. Movement: *Functional Movement Systems, Screening – Assessment – Corrective Strategies.* Lotus Publishing; 2011.
5. Sankar WN, Laird CT, Baldwin KD. Hip range of motion in children: what is the norm. *J Pediatr Orthop*. 2012;32(4):399-405.
6. Hamid MS, Ali MR, Yusof A. Interrater and intrarater reliability of the active knee extension (AKE) test among healthy adults. *J Phys Ther Sci*. 2013;25(8):957-61.
7. Herrington L. Assessment of the degree of pelvic tilt within a normal asymptomatic population. *Man Ther*. 2011;16(6):646-8.
8. Azevedo DC, Santos H, Carneiro RL, Andrade GT. Reliability of sagittal pelvic position assessments in standing, sitting and during hip flexion using palpation meter. *J Bodyw Mov Ther*. 2014;18(2):210-4.
9. Van Wingerden JP, Vleeming A, Snijders CJ, Stoeckart R. A functional-anatomical approach to the spine-pelvis mechanism: interaction between the biceps femoris muscle and the sacrotuberous ligament. *Eur Spine J*. 1993;2(3):140-4.
10. Harrison DE, Harrison DD, Troyanovich SJ. The sacroiliac joint: a review of anatomy and biomechanics with clinical implications. *J Manip Physiol Ther.* 1997;20(9): 607-17.
11. Franke BA. Formative dynamics: the pelvic girdle. *J Man Manip Ther.* 2003;11(1):12-40.
12. Van Wingerden JP, Van Wingerden JP, Vleeming A, Buyruk HM, Raissadat K. Stabilization of the sacroiliac joint in vivo: verification of muscular contribution to force closure of the pelvis. *Eur Spine J.* 2004;13(3):199-205.