Standing Flexion Test: A Manual Diagnostic Test as First Indication of Sacroiliac Dysfunction – Study from Practice

Standing Flexion Test / Vorlaufphänomen: Ein diagnostischer Test der manuellen Medizin als Hinweis auf eine sakroiliakale Dysfunktion – Studie aus der Praxis

Authors
Dana Loudovici-Krug[1, 2], Christina Lemhöfer[1], Norman Best[1]

Affiliations
1 Institute for Physiotherapy, Jena University Hospital, Jena
2 Research Consulting office of the ÄMM (Medical Association Manual Medicine)

Key words
Sacroiliac joint, Manual therapy, Diagnostics, Inspection and palpation

Schlüsselwörter
Sacroiliakalgelenk, Manuelle Therapie, Diagnostik, Inspektion und Palpation

received 08.06.2022
accepted 24.10.2022
published online 18.11.2022

Bibliography
Phys Med Rehab Kuror 2024; 34: 11–17
DOI 10.1055/a-1967-2509
ISSN 0940-6689

Georg Thieme Verlag, Rüdigerstraße 14,
70469 Stuttgart, Germany

Correspondence
Dana Loudovici-Krug
Institute for Physiotherapie
Jena University Hospital
07747 Am Klinikum 1
Jena
dana.loudovici@med.uni-jena.de

ABSTRACT

Background The standing flexion test (SFT) is an orienting test, supporting to diagnose a sacroiliac joint dysfunction (SIJ-D) in manual medicine. However, the literature research for this term shows the paucity of according investigations. The aim is to investigate the importance of the SFT with regard to possible functional disorder of the SIJ.
Method Teachers of the Medical Association for Manual Medicine (physiotherapists and physicians) were asked to fill in a documentation sheet considering different exsmination procedures belonging to routine manual medicine anamnestic findings. The only inclusion criterion was the positive SFT. The results are presented descriptive with according percentages.
Results From January to August 2019, a total of 366 SIJ data sheets with positive SFTs were completed by 20 ÄMM-teachers, involving six imcomplete ones. 263 of the 360 patients enrolled actually had a SIJ-D (73.06 %).
Further relevant results refer to pain oft he SIJ region (205 of 360; 173 with SIJ-D), the Patrick-Kubis-Test (246 of 360; 201 with SIJ-D), the pelvic tilt (134 of 360; 134 with SIJ-D), the pelvic torsion (209 of 360; 164 with SIJ-D) and the increased iliac muscle tone (282 of 360; 216 with SIJ-D).
Discussion After a positive SFT, the Patrick-Kubis-test, the tonus check of the iliac muscle and the indication of pain in the SIJ-region can be used for the diagnosis of a SIJ-D. If at least two of the three aspects are conspicuous, SIJ-D is very likely to be present.

ZUSAMMENFASSUNG

Hintergrund Der Standing Flexion Test/Vorlaufphänomen (SFT) ist ein orientierender Test, der in der manuellen Medizin für die Diagnose einer Dysfunktion des Sakroiliakalgenks (SIG-D) genutzt wird. In der Literatur gibt es nur wenig Untersuchungen zu dieser Testmethode. Ziel ist es daher, die Bedeutung des SFT im Rahmen der Diagnostik für eine mögliche Funktionsstörung des SIG zu untersuchen.
Methode Lehrende der Ärztevereinigung für Manuelle Medizin (Physiotherapeuten und Ärzte der ÄMM) wurden gebeten, einen Dokumentationsbogen mit verschiedenen Einzeltests auszufüllen, die zur manualmedizinischen Routine gehören. Eingeschlossen wurden nur Bögen, bei denen ein positiver SFT dokumentiert wurde. Die Ergebnisse werden deskriptiv mit entsprechenden Prozentangaben dargestellt.
Ergebnisse Von Januar bis August 2019 wurden von 20 ÄMM-Lehrenden insgesamt 366 SIG-Datenblätter mit positiven SFTs ausgefüllt, darunter sechs unvollständige. 263 der 360 erfassten Patienten hatten tatsächlich ein SIG-D (73,06 %).
Weitere relevante Ergebnisse beziehen sich auf Schmerzen im Bereich des SIG (205 von 360; 173 mit SIG-D), den Patrick-Kubis-Test (246 von 360; 201 mit SIG-D), die Beckenkippung (134 von 360; 134 mit SIG-D), die Beckentorsion (209 von 360;

164 mit SIG-D) und den erhöhten Tonus der Beckenmuskulatur (282 von 360; 216 mit SIG-D).

Diskussion Nach einem positiven SFT können der Patrick-Kubis-Test, die Tonusprüfung des M. iliacus und der Hinweis auf Schmerzen in der SIG-Region zur Diagnose einer SIG-D zur weiteren Verifizierung herangezogen werden. Wenn mindestens zwei der drei Aspekte auffällig sind, liegt mit hoher Wahrscheinlichkeit eine SIG-D vor.

ABBREVATIONS

SIJ sacroiliac joint
SIJ-D sacroiliac joint dysfunction

Background

In manual medicine or manual therapy, the orienting test called standing flexion test (SFT) or "Vorlauf test" is frequently used. For this purpose, the patient, standing hip-width apart, leans forward with extended knees. Meanwhile, the examiner palpates both posterior superior iliac spines (PSIS) and follows the movement. The test is positive if the movement of the PSIS is more on one side of the pelvis than on the opposite side. This test is for manual diagnosis as an indication of possible sacroiliac joint (SIJ) dysfunction. Checking the SFT is sensitive for changes in the SIJ, but not specific, so that a conspicuous finding may also be due to asymmetrical tension conditions of the ischiocrural musculature [1]. In diagnostics, this serves as the first indication of a possible functional disorder of the SIJ. Therefore, "SIJ somatic dysfunction" should then be specifically investigated by SIJ springing test or other targeted functional testing [2].

A literature search using the keyword "standing flexion test" yielded eight hits between 1987 and 2021, reflecting the paucity of scientific investigation of this test. Among the hits is a meta-analysis including Systematic Review [3] and a randomized controlled trial [4].

For example, in a clinical study, this test is used as a measurement tool to assess SIJ mobility before and after manipulation [5].

The SFT was also applied to investigate SIJ dysfunction (SIJ-D) in a rowing team [6]. Besides palpation, SFT was the only diagnostic test to detect any dysfunction.

Another cross-sectional study examined the SIJ of construction workers [7]. As one of three palpation tests, the SFT was used for SIJ diagnosis. This allowed detection of mainly asymptomatic SIJ-D. Therefore, the authors point out the importance of a pain symptomatology for a SIJ-D to be treated. Furthermore, the three palpation tests used (SFT, spine test, iliac springing test) showed similar results [8]. This speaks well for agreement of the tests, but not yet for validity with respect to an existing SIJ-D.

A reliability study was conducted to test both inter- and intra-tester reliability [4]. However, it should be considered here that osteopathy students of the last year of training acted as examiners (n = 9) and the subjects (n = 9) were asymptomatic without limitations in the SIJ area. Only 42 % agreement could be determined with respect to inter-tester reliability and 68 % with respect to intra-tester reliability. Due to the low reliability values, the validity of the test is questionable. It is possible that the agreement increases in symptomatic patients.

The conclusion of a reliable test for healthy persons, as long as the SFT is performed by the same rater, was currently reached by another team of authors [3]. Furthermore, they confirmed the construct validity of the flexion test in standing, but not in sitting. However, the limitation that these are subjects without complaints must also be taken into account here. A cross-sectional study assessed functional limitation after joint replacement at the hip joint [9]. Thereby, the SFT belonged to a test battery of five procedures, two of which had to be declared as conspicuous for a positive finding. However, the authors stated that there was a risk of false-positive results in this group of patients, firstly due to a positive Trendelenburg sign contralaterally and secondly due to a dysfunction of the lumbar vertebral segments.

These study examples highlight the use of the SFT to identify SIJ-D. However, it is unclear how valid the test is or whether SIJ-D can actually be assumed after a positive finding.

Thus, the focus and aim of this study is on the SFT: To what degree does this finding agree with other SIJ investigations? How often is a positive SFT actually accompanied by a SIJ-D? What statement can be made about an existing pain symptomatology? Is the SFT or "Vorlauf test" an important hint with regard to a possible functional disorder of the SIJ? Thus, this study will examine orienting tests that provide evidence of SIJ-Dysfunction and can subsequently be confirmed or disproved by a specific diagnostic SIJ test.

Material and Methods

The orienting examination of the SIJ by means of SFT is obligatory in the manual medicine or manual therapy sdiagnostics of many curricula. Other aspects, such as statements on pelvic statics or pain symptoms, are also routine tests that are used in daily practice. For this reason, a form was created for this observational study, which corresponds to the examination algorithm and can therefore be completed without extensive additional effort (see ▶ **Fig. 1**).

From top to bottom, each line should be marked with a cross to indicate whether the test was positive and, if so, on which side of the body the test was noticeable.

The final test is for SIJ-D. There are various diagnostic tests to verify this: Springing test in prone position/counter nutation ("Stoddard"), springing test in prone position/external rotation of the ilium or springing test in lateral position/internal rotation of the ilium [2, 10]. However, like for many diagnosing tests in manual medicine/manual therapy, there is a lack of an existing gold standard [11].

Teachers of the Medical Association for Manual Medicine (Ärztevereinigung für Manuelle Medizin/ÄMM, Berlin) of the German Society for Manual Medicine (Deutsche Gesellschaft für Manuelle Medizin/DGMM) previously critically reviewed the form as well as tested it for practicability within everyday therapeutic and medical patient routines. In Germany, physicians with certification pro-

vide manual medicine treatment; physiotherapists with according certification offer manual therapy, too.

The ethics committee of the Friedrich Schiller University Jena approved the study as a routine measurement or recording of routine data (number: 2019–1280-Data).

The study design was presented to all teachers at ÄMM during a teachers' symposium and they were asked to participate. In total, nearly 100 instructors teach manual therapy respectively manual medicine in the ÄMM, both physiotherapists and physicians. Thus, it was conceivable that a case number of more than 500 subjects could be reached.

The completed questionnaires were sent to the ÄMM research consulting office, where data entry, statistics, and analysis were performed independently and in a blinded manner. This could be done in different ways: via mail in the pencil-paper version, as a scan via email or as a PDF version to be filled out online via email. The form was distributed as a multiple print version during the study presentation. In addition, the teachers received the document as a normal PDF or as an interactive PDF via email distribution. Lastly, a specially created QR code also served as a retrieval option on the web. This was to ensure that the hurdle to being able to use the required document was as low as possible.

The only inclusion criterion for study participation is the presence of a positive SFT. As soon as this is given, the patient can and should be included as a study participant. Neither age nor gender dependence should affect the results, so that a cross-sectional study of patients from a manual medicine/therapy-oriented outpatient clinic or practice can actually be formed.

Statistically, crosstabs are used, which additionally reflect the percentage value in the rows (IBM SPSS Statistics, version 26).

Results

From January to August 2019, a total of 366 SIJ data sheets with positive SFTs and another 90 without positive SFTs were completed by 20 ÄMM-teachers and submitted for further processing.

In the case of a few incomplete or unclearly completed sheets, misunderstandings could be circumvented on demand, so that with the exception of six copies, 360 data sets were analyzed.

The results now presented belong to the 360 subjects who showed a positive SFT finding of a SIJ.

Of the 360 subjects with positive SFT, 263 actually had SIJ-D, i. e. 73.06 %. There was no clustering of one side, as the right SIJ had an abnormality in 51 % and the left SIJ in 43 % of the cases. The remaining findings were present on both sides.

Furthermore, only 117 subjects (32.25 %) also showed a positive test procedure in sitting. A comparison shows that in the case of a missing positive flexion test result in standing, a missing positive finding in sitting is acceptable with a high probability (94.4 %). This difference is highly significant (p = .000).

However, it is noticeable that there is no change of side when a SFT finding is present in both standing and sitting. On the left side the test result coincides 92 % and on the right side even 96.6 %.

Slightly more than half of the subjects reported pain symptoms in the SIJ region (n = 205; 56.9 %). Of the 263 subjects with SIJ-D, only 65.8 % confirmed pain. Of the 97 subjects without SIJ-D, 67 % were also pain-free.

However, when someone reported pain in the SIJ region, it is 84.4 % consistent with an SIJ-D. Without pain symptoms, a SIJ-D is detectable in 58.1 %. This also shows a tendency of laterality: with pain on the right side, a right-sided SIJ-D is also present (75.5 %). This circumstance is weaker on the left side, as here 66.7 % of the dysfunction is also on the left.

The Patrick-Kubis test is positive in 246 subjects (68.3 %). If we consider only the 263 subjects with diagnosed SIJ-D, 201 positive Patrick-Kubis tests stand out, so that 81.7 % ultimately show dysfunction. The laterality of the dysfunction corresponds largely to that of the positive Patrick test, in figures 77.8 % for the right and 76.1 % for the left.

209 subjects (58.1 %) showed pelvic torsion. Of these, 78.5 % also have SIJ-D. The number of pelvic tilts is reduced to 167 subjects (46.4 %), but 80.2 % of them show a SIJ-D. A laterality cannot be determined in this case. However, it is noticeable that the pelvic tilts numerically predominate on the left side.

A tonus elevation of the iliacus muscle was detectable in 282 cases (78.3 %). There is no concordance of the elevated anterior superior iliac spine (ASIS) with equilateral muscle tone elevation. With existing tonus elevation, SIJ-D is present in 76.6 % of cases.

▶ **Table 1** illustrates an overview of conspicuous results. In nine participants, a positive SFT was present but no other conspicuous findings. Manual diagnosis excluded SIJ-D in each of these cases in this study.

Discussion

In this study, the SFT was investigated in conjunction with other functional SIJ tests for the manual diagnosis of a SIJ-D. It is well known that the SFT as a sole test does not provide a valid indication of dysfunction. A reliable finding is more likely to be obtained with various pain provocation tests. For example, Beyerlein & Bessler state that 3 of 5 provocation tests must be positive to detect SIJ-D [12]. Riddle & Freburger likewise recommend the use of pain provocation testing to determine dysfunction, less testing to measure pelvic symmetry and motion [13]. The study result of von Heymann et al. also focuses on 2 pain provocation points in the gluteal muscles, combined with the tight-thrust test because of the better agreement values. However, the addition of "3 out of 5" tests

▶ **Table 1** Conspicuous results referring to SFT and further tests.

SFT	further tests	Number of n = 360	SIJ-D = 263		= SIJ-D (yes)
			yes	no	
yes n = 360	pain SIJ	205	173	32	84.4 %
	Patrick-Kubis	246	201	45	81.7 %
	pelvic tilt	167	134	33	80.2 %
	pelvic torsion	209	164	45	78.5 %
	↑ muscle tone	282	216	66	76.6 %

SIJ-observation study

FBS MM

Date of examination ☐☐.☐☐.☐☐ Proband (Initials) ☐☐

Age ☐☐ Sex f m d

voluntary Statement: regular, same movement (sports, working routine, hobbies...)?

please mark with a cross where applicable: ✖

			If yes, which side?	
Standing Flexion Test (beginning):	yes	no	right	left
Sitting Flexion Test:	yes	no	right	left
Pain (SIJ region)	yes	no	right	left
Pelvic tilt	yes	no	right	left
Pelvis Torsion	yes	no		
• PSIS high?			right	left
• ASIS high?			right	left
Patrick positive	yes	no	right	left
• > 45°?	yes	no		
• Pain during performing?	yes	no		
Muscle tone increase of M. iliacus	yes	no	right	left
SIJ dysfunction	yes	no	right	left

▶ **Fig. 1** SIJ Form.

by means of additional functional test, here Patrick test as well as Gaenslen test, is also suggested [14].

A correlation study by Soleimanifar et al. examined the results of SIJ palpation testing with SIJ pain provocation testing [15]. They could not find a significant correlation between both test categories and point out that palpation tests check for dysfunction, but pain tests just primarily check for pain in the area of the SIJ.

The results presented here can be used to identify functional findings of the SIJ and possible relationships to other joint structures that are common in SIJ-D. These functional tests include regional pain, a positive Patrick-Kubis test, pelvic torsion, pelvic tilt/depression, or muscle tone elevation on the ipsilateral side.

Accordingly, the anamnestic tests can or should be checked consecutively after a positive SFT. This is because if only the SFT and no other test is positive, SIJ-D is more likely to be ruled out. It is possible that the positive SFT is then an expression of a movement disorder in the sense of pathological stereotypes. These disorders occur in healthy individuals as well as in patients [16, 17].

It is not surprising that a positive SFT gives no indication of the side of presumed SIJ-D. This is probably because the pelvic ring combines static, elastic, and contractile portions. Thus, a mechanical structure is created that can be relatively flexible (example: single-leg stance and twisting of the entire pelvic ring) as well as impart great stability (example: wide-legged stance, lifting loads, landing after jumping). Referring to the data collected here, there is a high probability that dysfunction of one of the SIJs is present if a positive SFT could be triggered and other abnormalities exist. However, it was not verified that there was no SIJ-D in the nearly 27 % of cases, as dysfunction might have been found in the symphysis or myofascial region within the small pelvis. This could possibly cause the SFT to test positive as well.

Only one third of the subjects also showed a positive sitting flexion test with a positive SFT. Consequently, after a negative SFT finding, flexion testing in the sitting position could be omitted. However, it is striking that the ipsilateral side is often prominent in the case of an additional conspicuous finding in sitting. According to current cybernetic models, this tends to suggest that after sitting and thus "opening the chain downward," the myofascial interference pattern is lost from the area of the lower extremities. This in turn means that significantly more interference effects are mediated into the pelvis via the lower extremities than from cranial. Thus, the statement that the temporomandibular joint frequently influences pelvic asymmetries is questionable. According to the data collected here, the caudal parts of the musculoskeletal system are more often to be the reason. Besides the so often postulated temporomandibular joints, eye movements are possibly much more frequently to be facilitated, as this can influence trunk stability and balance ability [18]. However, it also shows that by activity of the upper extremity with "closed lower chain" that muscle actions in the lower extremities are measurable [19, 20].

Furthermore, the present result supports the hypothesis that closed chains in the kinetic movement system, due to the reduced possibility of adaptation, transmit dysfunctions more frequently than open chains. Further studies are needed to confirm this hypothesis and exclusively consider the pathology of these myofascial chains including the corresponding therapy.

If the flexion test is also triggered while sitting, it appears that the "interference chain from cranial" is unimpressed by the change of position. The functionally abnormal side remains even in sitting. Accordingly, it is to assume that there is a relatively stable dysfunction from cranial to pelvic. This, in turn, could be an expression of a clearly arthrogenic or longstanding facilitated, and therefore already chronified, altered functional chain of the upper half of the musculoskeletal system as a trigger.

The assumption that functional disorders in the musculoskeletal system are always painful is refuted here. Only about 50 % of those with SIJ-D also complained about pain. This speaks for the fact that functional disorders often run segmentally and are not overly represented by ascending systems, in the sense of pain perception. However, it cannot be clarified here whether the patients studied had pain events in the past, possibly because of initially occurring SIJ-D, and this pain is now no longer perceived. Nevertheless, the thesis that dysfunction is synonymous with pain cannot be held.

The Patrick-Kubis sign (hyperabduction test) indicates equilateral dysfunction of the adductors, hip joint, SIJ, and lumbosacral junction, according to current lumbosacral transition [21, 22]. Two out of thress patients show a positive Patrick-Kubis test, but not all have SIJ-D. However, if there is a SIJ-D, then over 80 % will also have a positive Patrick-Kubis test. This means that if the combination test of SFT and Patrick-Kubis test is positive in each case, then there is a 76 % chance that SIJ-D, primarily of the ipsilateral side, is present.

The biomechanical stress of a pelvic tilt or depression seems to be so strong that 80 % of the examined patients with a positive SFT also show a dysfunction of the SIJ. In other words, a SIJ-D can also be so strong that a pelvic depression occurs in the following. In the case of pelvic torsion, as an expression of myofascial dysfunction of the pelvis as a whole, SIJ-D are less common. Accordingly, a positive SFT does not necessarily indicate a twisted pelvis. However, if one has pelvic torsion, 3 out of 4 patients also have a dysfunction.

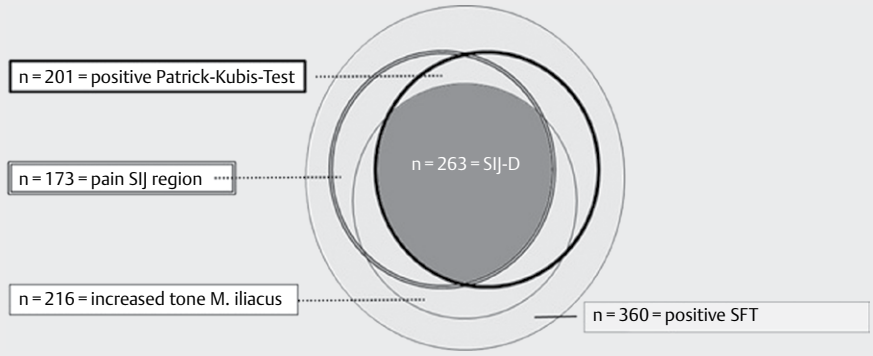
The theory that a tense iliac muscle causes the ASIS to be higher on the same side cannot be proven. The agreement is less than one third on each side. It showed that a positive SFT is often accompanied by an increase in tone of the iliacus muscle. If there is a SIJ-D, then independently of the side, two thirds also show a dysfunction of this muscle.

By counting the frequencies, consideration can be given to which tests or examinations may be useful in diagnosing a SIJ-D. After a positive SFT, the Patrick-Kubis test, the tonus check of the iliac muscle and the indication of pain in the region in question can be used for this purpose (▶ **Fig. 2**). If at least two of the three aspects are conspicuous, SIJ-D is very likely to be present.

The aspect of pain is consistent with the conclusion drawn by Freburger and Riddle [23]. Here, pain description, in conjunction with pain provocation, is recommendable to diagnose a so-called SIJ-D.

The exclusive use of individual mobility tests in the SIJ examination is problematic [24]. However, the reiliabilty for a test cluster is higher [25].

One limitation of this observational study is the heterogeneous patient clientele. On the one hand, all participants were simultaneously patients who presented to a medical consultation. On the



▶ **Fig. 2** Useful tests to diagnose SIJ.

other hand, this was mostly not primarily due to existing SIJ complaints. Thus, no concrete correlation between the complaint pattern and the actual pathology can be determined. Furthermore, the question remains whether and if so, which causal chains exist in the development of complex complaint patterns.

From a methodological point of view, the question arises as to the technique used to test a SIJ-D. There may be variations here with respect to assessment, already mentioned in the methods part. Furthermore, the question arises whether the examiner's handedness has an influence on the test result and thus on the presence of an SIJ-D. This could be the subject of a further study.

Conclusion

In summary, we can state that in the case of a positive SFT in combination with a positive Patrick-Kubis test, the probability of the presence of a secondary SIJ-D is very high. In addition, the muscle tone of the iliac muscle should be checked by palpation and the patient should be asked about existing pain.

Moreover, the interference factors from the lower extremities to the pelvis are much more frequent than those of the trunk and, consequently, the upper extremities as well as the temporomandibular joint region. When the disturbance refers from cranial and reaches the pelvis, it appears to be manifest and perpetuated. This could argue that this disturbance is more arthritic in origin.

Future studies should be done to investigate why 27 %, a close quarter, of patients with positive SFT do not have SIJ-D. Possibly, punctate disorders of the pubic region or visceral portions of the pelvis could be causative.

Disclosure statements

There are no relevant financial or non-financial competing interests to report.

Conflict of Interest

The authors declare that they have no conflict of interest.

Literatur

[1] Greenman PE. Principles of manual medicine. Lippincott Williams & Wilkins; 2003

[2] Schildt-Rudloff K, Harke G. Wirbelsäule: Manuelle Untersuchung und Mobilisationsbehandlung für Ärzte und Physiotherapeuten. Fischer Gustav Verlag GmbH & Company KG; 2016

[3] Ribeiro RP, Guerrero FG, Camargo EN et al. Construct validity and reliability of tests for sacroiliac dysfunction: standing flexion test (STFT) and sitting flexion test (SIFT). Journal of Osteopathic Medicine 2021; 121: 849–856

[4] Vincent-Smith B, Gibbons P. Inter-examiner and intra-examiner reliability of the standing flexion test. Manual therapy 1999; 4: 87–93

[5] Barbosa AWC, Silva AM, Silva AF et al. Immediate improvements in activation amplitude levels of the deep abdominal muscle following a sacroiliac joint manipulation during rapid upper limb movement. Journal of bodywork and movement therapies 2014; 18: 626–632

[6] Timm KE. Sacroiliac joint dysfunction in elite rowers. Journal of Orthopaedic & Sports Physical Therapy 1999; 29: 288–293

[7] Toussaint R, Gawlik CS, Rehder U et al. Sacroiliac dysfunction in construction workers. Journal of manipulative and physiological therapeutics 1999; 22: 134–138

[8] Toussaint R, Gawlik CS, Rehder U et al. Sacroiliac joint diagnostics in the Hamburg construction workers study. Journal of manipulative and physiological therapeutics 1999; 22: 139–143

[9] Pap A, Maager M, Kolarz G. Functional impairment of the sacroiliac joint after total hip replacement. International rehabilitation medicine 1986; 8: 145–147

[10] Lewit K. Manipulative therapy in rehabilitation of the motor system. Toronto: Butterworth & Co; 1985

[11] Patijn J. Reproducibility protocol for diagnostic procedures in Manual/Musculoskeletal Medicine. Manuelle Medizin 2019; 57: 451–479

[12] Beyerlein C, Bessler J. Der sichere Weg zur Diagnose. physiopraxis 2006; 4: 20–24

[13] Riddle DL, Freburger JK. North American Orthopaedic Rehabilitation Research Network. Evaluation of the presence of sacroiliac joint region dysfunction using a combination of tests: a multicenter intertester reliability study. Physical therapy 2002; 82: 772–781

[14] von Heymann W, Moll H, Rauch G. Study on sacroiliac joint diagnostics. Manuelle Medizin 2018; 56: 239–248. doi:10.1007/s00337-018-0405-6

[15] Soleimanifar M, Karimi N, Arab AM. Association between composites of selected motion palpation and pain provocation tests for sacroiliac joint disorders. Journal of bodywork and movement therapies 2017; 21: 240–245

[16] Best N, Loudovici-Krug D, Zeits P et al. Klinische Anwendung des Bregmatests. Der Schmerz 2020; 34: 319–325

[17] Best N, Senftleben U, Rottländer K et al. Reliabilität und Validität des Bregma-Tests. Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin 2020; 30: 168–173

[18] Kim DH, Kim K-H, Lee S-M. Effects of Eye Movement with PNF Neck Movement on Trunk Stability and Standing Position Balance Ability of Chronic Stroke Patients. Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin 2020; 30: 206–213

[19] Best N, Schildt-Rudloff K, Strohbach D et al. Krankengymnastische Haltungskorrektur mittels Fazilitation über die Hände „Hands Induced Posture "(HIP) – eine Einführung. Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin 2019; 29: 94–98

[20] Best S, Anders C, Best N. Untersuchung von Aktivierungsmustern posturaler Muskulatur durch Fazilitation über die Hände „Hands Induced Posture "(HIP) mittels O-EMG-Teil 1: Prüfung der Reliabilitätswerte der Versuchsanordnung. Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin 2020; 23: 229–241

[21] Harke G, Linz W, Rösel A. Extremitätengelenke: manuelle Untersuchung und Mobilisationsbehandlung für Ärzte und Physiotherapeuten. Elsevier Health Sciences 2020

[22] Olson KA. Manual Physical Therapy of the Spine-E-Book. Elsevier Health Sciences 2015

[23] Freburger JK, Riddle DL. Using published evidence to guide the examination of the sacroiliac joint region. Physical therapy 2001; 81: 1135–1143

[24] Klerx SP, Pool JJ, Coppieters MW et al. Clinimetric properties of sacroiliac joint mobility tests: a systematic review. Musculoskeletal science and practice 2020; 48: 102090

[25] Arab AM, Abdollahi I, Joghataei MT et al. Inter-and intra-examiner reliability of single and composites of selected motion palpation and pain provocation tests for sacroiliac joint. Manual therapy 2009; 14: 213–221