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Is the Straight-Leg-Evaluation-Trauma-Test (SILENT Test) a Feasible Alternative to Routine Clinical Assessment of Injuries to the Lower Limb? - A Survey of Trauma Surgeons

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Abstract

Introduction: The novel Straight-Leg-Evaluation-Trauma-Test (SILENT) has been introduced as a standardized, rapid, and safe alternative to conventional clinical assessment of injuries to the lower extremity in the trauma bay setting. The aim of this study was to assess clinical experience of trauma surgeons with certain experience with the SILENT in the trauma bay.

Materials and Methods: Trauma surgeons from one academic trauma center were enquired to complete a survey with 32 questions, designed to evaluate the SILENT test. Feasibility, safety, certainty, duration and general questions were asked and compared with individual techniques of examining the lower extremities during Primary Survey in a trauma bay setting.

Results: This study included 56 MD participants, with the majority being ATLS providers (n = 46, 82.1%) and ten participants were ATLS instructors (17.9%). More than half (57.1%) of the participants supervise more than 100 trauma bay patients at the time of the study. Most participants reported the SILENT to be more standardized when compared to the routine examination (n = 44, 78.6%) and most participants declared the SILENT to be much more reproducible when compared to their routine examination (n = n = 44, 78.6%).

Conclusion: Numerous clinically active trauma surgeons with experience of performing the SILENT report the test to be a feasible, safe, and standardized alternative to conventional clinical assessment of injuries to the lower extremity in the trauma bay setting. A positive SILENT yields recommendation for further radiographical evaluation.

Keywords: SILENT test; Trauma bay; ATLS; Physical examination; Primary survey; Clinical evaluation

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Introduction

The initial assessment of major trauma patients adheres to internationally standardized and validated protocols. According to these guidelines, the primary survey involves the identification of life-threatening injuries, requiring the trauma team to swiftly and accurately identify such conditions. The evaluation focuses on critical areas including the chest, abdomen, pelvis, and femur, where life-threatening bleeding sources are most commonly found [1]. According to these guidelines, the initial survey involves the identification of life-threatening injuries, and the trauma team must swiftly and accurately identify such injuries [2].

After this initial clinical assessment, the trauma team determines the necessity of a trauma CT scan, which typically includes imaging of the head, spinal axis, chest, abdomen, pelvis, and hip joint, but does not extend beyond the lesser trochanter unless additional examinations are requested.

In addition to these established clinical assessment tools, the Straight-Leg-Evaluation-Trauma-

Test (SILENT) was introduced in 2022 as a feasible and rapid clinical test for detecting injuries of the lower extremities [3,4]. In brief, the SILENT involves the examiner elevating the heel and assessing the pain, mobility, and strength of the extremity. If the SILENT test is positive, indicating potential injury, additional radiological images are incorporated into the routine imaging protocol [4].

Currently, the SILENT is under evaluation as a standardized clinical assessment tool for the rapid and safe evaluation of the lower extremity. This new test aims to address the high incidence of missed lower extremity injuries, which are not routinely included in standard trauma CT scans. The integration of the SILENT test into trauma assessments could enhance the detection of significant injuries and improve patient outcomes by ensuring that all potential injuries are promptly and accurately identified. This study aimed to assess the reproducibility, safety, and confidence in the SILENT test from medical professionals.

Material and Methods

Ethical consideration

The local institutional review board waived ethical approval for this longitudinal survey. Reporting of the data follows the Consensus –Based Checklist for Reporting of Survey Studies (CROSS) [5].

Questionnaire

The questionnaire consisted of 32 questions and was designed to gather comprehensive data on various aspects of the SILENT test. The first section collected routine demographic information, including the respondent's status as an ATLS instructor or provider, years of experience in the trauma bay, the number of supervised trauma cases, experience with the SILENT test, and the number of times the SILENT test was performed.

The second section of the questionnaire focused on comparing the SILENT test with the routine clinical assessments that each physician used prior to the introduction of the SILENT test. This section included questions regarding the standardization and reproducibility of the SILENT test, as well as the associated risks for patients and the potential for additional injuries. By examining these factors, the survey aimed to evaluate the overall efficacy and safety of the SILENT test compared to traditional assessment methods.

The third section of the questionnaire concentrated on the examiners' confidence and the subsequent steps they would take if the SILENT test was considered positive. It included questions about the examiner's confidence in detecting injuries to the hip, knee, femoral shaft, or tibia shaft. Additionally, it covered the actions the examiner would take, such as whether they would splint the leg if the SILENT test was positive or if further imaging would be warranted. This section aimed to understand how the SILENT test influences clinical decision-making and the management of suspected lower extremity injuries.

The final section assessed the performance of the SILENT test with a focus on time and feasibility. It included questions about whether the SILENT test is faster than the routine assessment, if the SILENT test would result in delays in the initial trauma bay management, and if the SILENT test would improve workflow in the trauma bay.

The survey was conducted online and if a question was not answered, the online questionnaire system did not allow the questionnaire to be advanced or completed.

Sample characteristics

Clinically active trauma surgeons employed at an academic trauma center, who regularly treated trauma patients in a trauma bay setting, were included in this study. Participation was anonymous and voluntary. We used a single-stage, simple random sampling technique to select trauma surgeons from our academic trauma center. Our goal was to include the maximum number of participants possible, and we did not perform a formal sample size calculation. Given their routine involvement in trauma bay management, the participants are considered representative of trauma surgeons in this setting. Multiple participation was prevented utilizing one specific link per participant that cannot be used multiple times. The study and the questionnaires were presented prior the conduction of the study and during questionnaire the study team was available for potential follow-up questions.

Statistical analyses

The questions provide categorical answer possibilities. These answers are presented with count and percentage. Descriptive statistic includes presenting data with mean, standard deviation (SD) for continuous variables and count and percentage for categorical parameters. There was no loss to follow-up. Group comparisons were not performed as this survey aimed to present the descriptive data. Calculations and graphs were performed with R (R Core Team (2024). _R: A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>).

Results

This study included 56 participants, with the majority being male

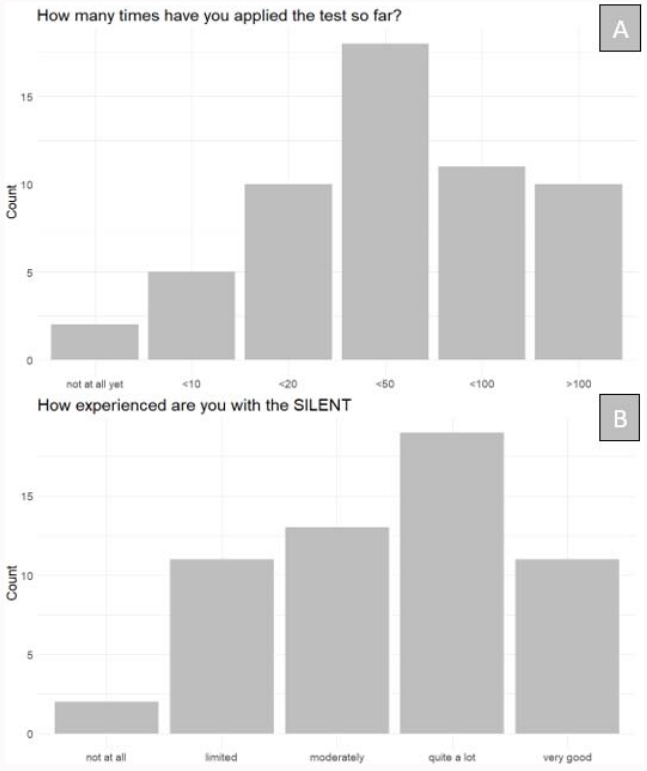

Figure 1: (A) Participants report on the number of performed SILENT up until the survey.
(B) A self-evaluation of the experience the participants had with SILENT until the time-point of the survey.

Table 1: Demographics of study participants.

Demographics of participants	
n	56
Gender, n (%)	
Did not want to disclose	4 (7.1)
female	19 (33.9)
male	33 (58.9)
ATLS Provider, n (%)	46 (82.1)
ATLS Instructor, n (%)	10 (17.9)
Years of experience in the trauma bay, n (%)	
<1	5 (8.9)
<3	14 (25.0)
<5	12 (21.4)
<10	12 (21.4)
<20	7 (12.5)
>20	6 (10.7)
How many trauma patients have you supervised in the trauma bay so far? (%)	
<10	5 (8.9)
<20	3 (5.4)
<50	8 (14.3)
<100	8 (14.3)
>100	32 (57.1)

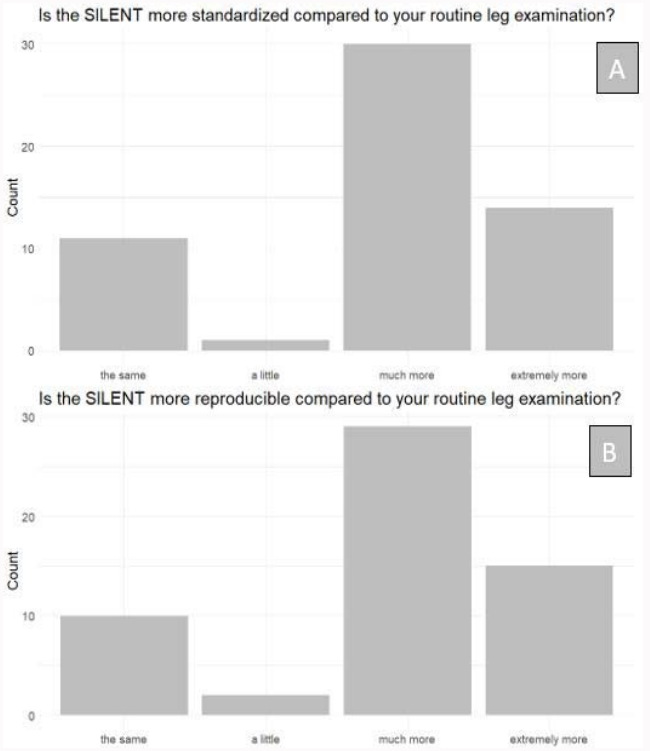

Figure 2: A: Participants declared that the SILENT is more standardized when compared to their routine examination.
B: Participants further reported that the SILENT is more reproducible when compared to their routine examination.

participants (n=33, 58.9%). The majority of participants are ATLS providers (n=46, 82.1%), and ten participants were ATLS instructors (17.9%). Most participants supervise more than 100 trauma bay patients (n=32, 57.1%) (Table 1).

Experience with SILENT and comparison to routine examination

The majority of participants reported to have quite a lot or very good experience with the SILENT (n = 30, 53.6%) and have applied the SILENT test more than 20 times (n = 39, 69.6%) (Figure 1). In total, 44 (78.6%) of participants reported the SILENT to be more standardized when compared to the routine examination. The SILENT has been reported to be much more reproducible when compared to routine examination (n = 44, 78.6%) (Figure 2).

Usability of the SILENT in the trauma bay and the pre-clinical setting

Nearly all participants declared that the SILENT is suitable during the primary survey in the trauma bay (n = 55, 98.2%). Forty participants (78.6%) declared the SILENT as safe enough to be performed by the emergency medical technicians. Most participants declared the SILENT to be faster when compared to their routine examination technique (n = 52, 92.9%).

Risk for patients

Eighteen participants (32.1%) declared the SILENT to have the same risk for patients when compared to the routine examination technique, while 23 (41.1%) reported the SILENT not to have any risk for the patients to suffer additional injuries (Figure 3).

Further steps after positive SILENT and confidence of the examination results

Nearly all participants would order further imaging after the SILENT was positive (n = 55, 98.2%) and 53 participants (94.6%) would splint the leg after the SILENT was positive. The positive SILENT led in 27 (48.2%) participants to report to be very confident that there is an injury to the leg, while the remaining 29 (41.8%) participants were rather confident about the presence of an injury to the leg. The highest reported confidence for the presence of a fracture was for femoral shaft ("very confident" n = 30, 53.6%, "rather confident" n = 26, 46.4%), followed by tibia shaft fracture ("very confident" n = 29, 51.8%, "rather confident" n=27, 48.2%). Participants reported to be less confident of a present injury around the joints of the lower extremity when the SILENT was positive (Table 2).

Implementation of the SILENT in the trauma bay

In total, 52 participants (92.9%) would immediately inform the

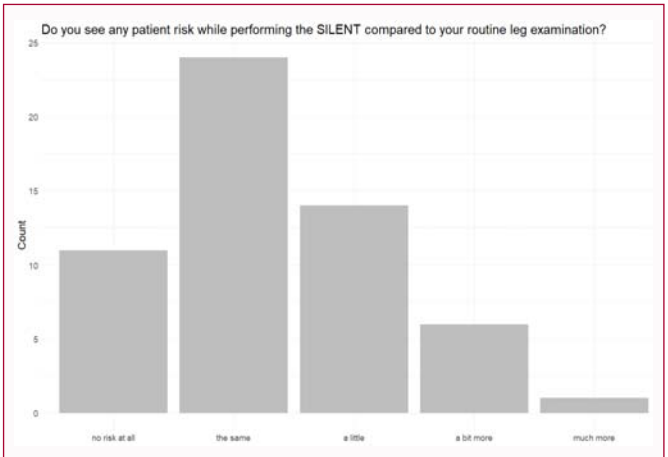

Figure 3: When compared to their routine examination technique most participants reported the SILENT to have similar risks for patients to suffer from additional injuries during examination.

Table 2: Reported confidence of the participants that an injury is present per anatomic location of the lower extremity.

Confidence of present injury after a positive SILENT				
	not at all confident	little confident	rather confident	very confident
n = 56				
Femoral shaft fracture			26 (46.4%)	30 (53.6%)
Tibia shaft fracture			27 (48.2%)	29 (51.8%)
Injury around the knee joint	1 (1.8%)	11 (19.6%)	33 (58.9%)	11 (19.6%)
Injury around the hip joint	3 (5.4%)	22 (39.3%)	26 (46.4%)	5 (8.9%)

trauma bay team about the positive SILENT, and 53 participants (94.6%) reported the SILENT to improve workflow in the trauma bay. Fifty-one participants (91.1%) would recommend the SILENT to be an integral part of the primary survey.

Discussion

Trauma patients benefit from standardized treatment algorithms as well as process procedures, that adhere to globally recognized standardized protocols [6]. Initial assessments are crucial for detecting the severity of injuries and initiating appropriate interventions [1]. The previously published SILENT aims toward filling the gap of rapid and standardized assessment of injuries to the lower extremity [3,4]. The SILENT showed higher certainty and higher predictive value for fractures compared to routine testing of the lower extremities [3,4].

The present study surveyed trauma surgeons with a certain experience with the SILENT, as a feasible alternative to routine clinical trauma bay assessment of injuries to the lower limb compared to standard examination of the lower extremities. We conclude the following points:

- The SILENT test appears to be more standardized and reproducible when compared with the routine tests.
- Participants did not declare an increased risk for iatrogenic injuries when performing the SILENT test compared to their routine examination.
- A positive SILENT result in further radiographic imaging of the appropriate region

A standardized and reproducible examination provides a clear structure during the training of new healthcare professionals that might help to maintain high-quality care by providing benchmarks, comparisons and improvements. While the assessment of thoracic, abdominal, and pelvic injuries are well described and trained (2), whereas the clinical assessment of lower extremities have not been described as detailed. Following the implementation of the SILENT experienced trauma surgeons report that the test is more standardized and reproducible compared to their routine examination method. Further the participants reported that the SILENT is feasible for the detection of femoral or tibial shaft fractures and therefore might help to detect more injuries distal to the trunc.

Up to 39% of injuries are not recorded during the Primary and even Secondary Survey, with up to 30% of these being clinically significant [7-10]. The most commonly overlooked injuries are found in the extremities, accounting for 43.4% [11]. Other studies reported a lack of documentation of injuries in the lower extremities alone ranging from 15.2% to 31% [10,12,13]. This might base on the lack of a standardized clinical examination method for the detection of lower extremity injuries. The present survey revealed a variety of responses ("Please briefly describe your routine leg examination in the trauma bay"), indicating that each examiner has a different examination technique. Some describe their examination very briefly, while others provide a very detailed and targeted examination. This strengthens the statement that there is no standard examination for the lower extremity, not even within the execution team working in the same unit at the same hospital.

The usual trauma bay CT scan routinely stops at the area of the lesser trochanter of the femur [14]. Most participants reported that a positive CT scan might indicate further radiological assessment of the appropriate area [15]. The step of a potentially extended whole body CT scan could avoid the need of additional, conventional radiographic imaging. Yet, "extended" whole body CT diagnostics, result in a significantly higher radiation exposure for the patient, which therefore must be critically discussed, considering the possible long-term consequences.

The presented results further showed that most participants would not order extended imaging in case of a negative SILENT, ultimately saving time, costs and radiation dose for the patient.

This study validates the significance of the SILENT, with 91.1% of respondents advocating for its implementation as a standard component in the Primary Survey. This consensus could highlight the recognized value and potential impact of the SILENT in improving patient outcomes.

The previous studies and the current study regarding the SILENT showed promising results with the potential for fewer missed injuries, potentially leading to shorter hospital stays, faster rehabilitation time, and cost efficiency [3,4].

Limitations

One major limitation of this study is the wide range of years in experience of the participants. Some young colleges only recently started working in the trauma department and were introduced to the SILENT at the beginning of their training in the trauma bay. Most of them had not previously treated trauma bay patients before and had not developed their own examination method for the lower extremity. A comparison of the SILENT with their own examination is therefore difficult. Further, the majority of respondents indicated that they are confident a specific lower extremity injury is present following a positive SILENT. However, this only applies to single injuries of the extremity. It remains unclear whether the respondents are equally confident when multiple injuries are present, e.g. a femur fracture and an ipsilateral knee injury or even tibia fracture.

Conclusion

The SILENT test is a simple and standardized assessment method for quick, safe and efficient detection of major injuries to the lower extremities and a feasible alternative in comparison to the examiner's individual examination methods. A negative SILENT does not require additional imaging in the acute trauma bay setting, whereas a positive SILENT leads to ordering further radiological imaging.

Authors Contributions

Colleen Höhne, Sascha Halvachizadeh: equal contribution, article writing, statistics, creation of survey, conducting survey.

Eftychios Bolierakis: data evaluation, manuscript workup.

Hatem Alabdulrahman: Manuscript workup, literature review.

Felix Karl-Ludwig Klingebiel: literature review, statistics.

Yannik Kalbas: manuscript workup, literature review.

Valentin Neuhaus: data evaluation and, writer of article.

Hans-Christoph Pape: manuscript workup and literature review.

Frank Hildebrand: manuscript workup and literature review.

Till Berk: study initiation, manuscript workup, article writing, literature review.

Ethical Approval and Consent to Participate

All methods were carried out in accordance with relevant guidelines and regulations. This study was performed in accordance with the principles of the Declaration of Helsinki. An ethical approval was not required for this study.

Funding

No external funding sources were utilized to conduct and complete this study.

Competing Interests

None of the authors have any conflicts of interest to declare.

Availability of Data and Materials

The collected data will be stored securely in our institute for 10 years. During this period, they are still available upon request. After 10 years, the data will be deleted, however, all the datasets analyzed or generated during this study will be available from corresponding author upon reasonable request.

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