TECHNICAL / DIAGNOSTIC STUDIES

acta orthopaedica belgica, 2025, 91, 547-552

doi.org/10.52628/91.4.14714

The IDO-Isometer: a valuable alternative for measuring the strength of external rotation of the shoulder: a comparative study between two measurement devices

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Background: **The hand-held dynamometer (HHD) is widely used to assess isometric shoulder strength but may present some limitations. The present study aimed to evaluate the reliability of the IDO-Isometer as a potential alternative for measuring isometric external rotation strength of the shoulder at 90° abduction.**

Methods: **Ninety asymptomatic adult volunteers (45 males, 45 females) underwent strength testing of both shoulders using an HHD and the IDO-Isometer. Measurements were performed in a standardized supine position with the shoulder abducted to 90° and the elbow flexed at 90°. Each device was used three times per shoulder with a 3-minute rest interval between devices. The sequence of testing was randomized. Intra- and inter-rater reliability of the IDO-Isometer were evaluated using Intraclass Correlation Coefficients (ICCs).**

Results: **The IDO-Isometer demonstrated excellent agreement with the HHD, with ICC values of 0.90 (95% CI: 0.85–0.93) for both dominant and non-dominant shoulders. Intra-rater reliability yielded ICCs of 0.95 and 0.92, and inter-rater reliability showed ICCs of 0.97 and 0.96, respectively.**

Conclusion: **The IDO-Isometer demonstrated excellent reliability for measuring isometric external rotation at 90° shoulder abduction. Given its lower cost and ease of use, it may represent a valuable alternative to the HHD in both clinical and research settings.**

Keywords: Isometric, Strength, Rotator Cuff, HandHeldDynamometer, IDOIsometer, ADLER Score.

INTRODUCTION

Multiple activities of daily living—such as combing hair, drinking, or brushing teeth—demand an external rotation force of the shoulder. This force is generated exclusively by two muscles: the infraspinatus and the teres minor. Impairment in either or both can significantly compromise functional ability. As Chen et al. have emphasized, a functional shoulder depends on muscular balance in both the vertical and horizontal planes. In the horizontal plane, internal rotators typically dominate over external rotators; with advancing age, atrophy of the rotator cuff further exacerbates this imbalance. Thus, preserving external rotation strength is essential to maintain a functional shoulder[1].

In clinical practice, several methods exist to measure external rotation strength. Manual Muscle Testing (MMT) is among the most commonly used: the patient holds the arm in maximal external rotation while the examiner applies counter-resistance, scoring strength from 0–5. A more quantitative approach utilizes a Hand Held Dynamometer (HHD), which digitally displays peak force during a self-selected interval. The HHD is portable and widely used across different muscle groups, but suffers from inconsistent standardization between testers. Stark et al. reported high intra-rater reliability with moderate inter-rater reliability for the HHD[2].

Another option is the IDO Isometer, developed by Innovative Design Orthopedics (Theale, UK), which measures elevation strength at 90° in the scapular plane. Kristensen et al. found it a valid and reliable alternative to conventional dynamometers for measurement of shoulder abduction or elevation. However, its application for assessing isometric external rotation force has not yet been described[3].

The present study aims to compare two measurement devices—HHD and IDO Isometer—for evaluating external rotation load while the shoulder is abducted

90°, and to establish normative isometric external rotation strength values for male and female subjects.

METHOD

Asymptomatic adult volunteers were recruited from a local university setting for a prospective cohort study. Participants completed the ADLER questionnaire (Appendix 1), which evaluates shoulder external rotation function. Individuals scoring below 30/30 were excluded. Additional exclusion criteria included current shoulder pain or any history of shoulder surgery. Passive range of motion (ROM) of each shoulder was then assessed in the supine position. Participants unable to passively achieve 90° shoulder abduction with 90° elbow flexion were excluded.

The required sample size was estimated from prior literature, indicating that with two raters, a significance level of 0.05 and 80% statistical power to detect an ICC of 0.70, at least 80 subjects were necessary. Prior to testing, participants provided signed informed consent. Two assessors performed all measurements, each thoroughly trained in the procedures[4,5].

Ultimately, 90 subjects underwent strength testing with both the hand held dynamometer (HHD) and the IDO Isometer to assess device agreement. Of these, 41 subjects returned three weeks later for retesting to evaluate intra rater reliability.

Isometric strength of the shoulder external rotators was measured using MicroFET2 HHD (Hoggan Health Industries, West Jordan, UT, USA) and IDO Isometer (Innovative Design Orthopaedics, Theale Reading, Berkshire, UK) (Figure 1 and 2).

A computerized randomization protocol designated the testing order (dominant vs. non dominant shoulder, HHD vs. IDO Isometer, and tester assignment) with no involvement from the assessors.

After a standardized warm up of multiplanar shoulder movements supervised by the testers, formal testing commenced. Participants lay supine with the shoulder abducted 90° and elbow flexed 90° to secure scapular position (Figures 3, 4). No additional limb stabilization was applied beyond the examination table, as this posture has been shown to provide functional scapular stabilization and maximal external rotation moment due to muscle length optimization[5].

For HHD measurements, the device was positioned 2 cm proximal to the ulnar styloid process on the dorsal forearm, and participants produced maximal external rotation effort. The IDO Isometer was attached via a string to a height adjustable metal bar. The string was similarly placed around the wrist

Appendix 1 — ADLER SCORE (Royal Berkshire, NHS Foundation Trust, Reading Shoulder Unit).

1	Comb hair	/3
2	Shave (men) or apply make up (women)	/3
3	Brush teeth	/3
4	Dress (ie put on shirt or coat without help)	/3
5	Fill a glass with a full bottle (while sitting at a table)	/3
6	Drink (bring a full glass to the mouth)	/3
7	Eat soup (with a full spoon)	/3
8	Shake someone's hand or open a door	/3
9	Use a phone (at ear level)	/3
10	Write a letter (or sign a paper or use a keyboard or play the piano)	/3
11	remove object from pocket opposite back pocket	/3
12	wash back opposite shoulder	/3

*All these activities should be performed without the help of flexing the neck or bending the trunk and without the help of first abducting the elbow (i.e., without doing a hornblower sign).

Fig. 1 — MicroFET 2 HHD
(Hoggan Health Industries Inc., West Jordan, UT, USA).

Fig. 2 — IDO Isometer
(Innovative Design Orthopaedics).

2 cm proximal to the ulnar styloid (Figure 5). In both methods, the forearm remained in neutral rotation[7-9].

Each participant completed one familiarization trial per device, followed by three recorded trials with 30 seconds rest between each. After a three minute rest period, testing was repeated on the same shoulder using the alternate device. During trials, encouragement was strictly verbal. No physical assistance was provided.

Inter rater reliability was assessed in 90 subjects, with measurements by each tester separated by a three minute interval. Intra rater reliability was determined in 41 subjects, with a mean retest interval of three weeks.

Statistical analysis was conducted using SPSS 25. Reliability was quantified using intra and inter class correlation coefficients (ICC). Systematic differences across trials or between testers were analyzed using paired t-tests or repeated-measures ANOVA for comparisons involving two or more conditions, respectively.

RESULTS

In total 90 subjects were included, ranging from minimum 18 years to a maximum of 96 years of age.

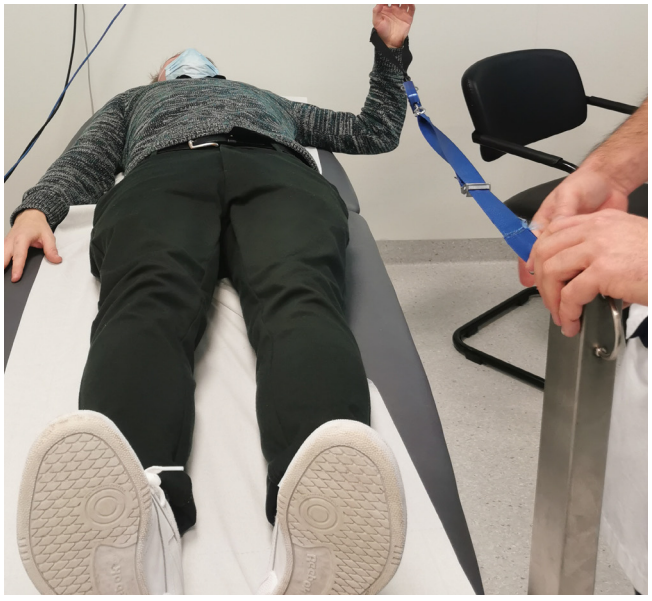

Fig. 3 — Position of subject.

Fig. 4 — Attachement of the IDO-Isometer.

Fig. 5 — 90° of shoulder abduction and elbow flexion.

Table I.

	Parameter	Min.	Max.	Mean	SD
Male	Age	18	93	37.7	20.8
	Height (cm)	156	192	179.6	6.8
	Weight (kg)	58	114	79.4	12.8
Female	Age	18	96	38.1	21.7
	Height (cm)	142	180	166.7	7.5
	Weight (kg)	47	98	65.3	10.9

The mean age of the cohort is illustrated in Table I. Body weight of each participant was documented at time of initial testing. The mean bodyweight was 79.4 kg (range 58 – 114 kg) for men and 65.3 kg (range 47 -92 kg) for women.

Comparison HDD – IDO Isometer (Table II and III)

All 90 participants (45 male, 45 female) underwent strength testing with both devices. In male participants, the mean external rotation strength across three trials using the HHD was 16.4 kg (SD 4.2) and 15.8 kg (SD 3.9), dominant and non-dominant shoulder respectively. Using the IDO-Isometer mean values were 14.4 kg (SD 4.2) and 13.6 kg (SD 4.4), dominant and non-dominant shoulder respectively.

Female participants demonstrated mean HHD strength of 9.1 kg (SD 2.4) and 8.7 kg (SD 2.3), dominant and non-dominant shoulder respectively. Corresponding IDO-Isometer measurements were 8.4 kg (SD 2.5) and 8.0 kg (SD 2.5), dominant and non-dominant shoulder respectively.

Agreement between devices was excellent, with ICC-value of 0.90 [95% CI 0.85 ; 0.93] for both dominant and non-dominant shoulder. According to Koo et al. an ICC $\geq$ 0.90 indicates excellent reliability[5].

Intra-rater reliability (Table IV)

Testing 41 subjects (82 shoulders) with IDO-isometer by the same tester with a mean interval of 3 weeks, the ICC amounts 0.95 [95% CI 0.90; 0.97] and 0.92 [95% CI 0.85 ; 0.96], dominant and non-dominant shoulder respectively. Following Koo et al. an ICC above 0.90 correlates with a good reliability[5].

Inter-rater reliability (Table V)

Testing 90 subjects (45 males, 45 females) with IDO-isometer by two different testers with a 3 minutes interval, the ICC amounts 0.97 [95% CI 0.95; 0.98] and 0.96 [95% CI 0.94 ; 0.95], dominant and non-dominant shoulder respectively. Following Koo et al. an ICC above 0.90 correlates with an excellent reliability[5].

DISCUSSION

This study compared two objective measurement methods for assessing isometric shoulder external rotation torque.

Table 2.

	Parameter	Dominant HHD	Non-dominant HHD	Dominant ISO	Non-Dominant ISO
Male	N	45	45	45	45
	Mean (SD)	16.4 (4.2)	15.8 (3.9)	14.4 (4.2)	13.6 (4.4)
	Min.	5.6	6.0	5.5	5.3
	Max.	22.8	21.2	20.9	20.4
Female	N	45	45	45	45
	Mean (SD)	9.1 (2.4)	8.7 (2.3)	8.4 (2.5)	8.0 (2.5)
	Min.	3.5	3.9	2.5	2.9
	Max.	13.1	13.4	14.4	14.8

HHD = Hand-Held Dynamometer; ISO = IDO-Isometer ; N = number of subjects ; SD = Standard deviation.

Table III. — HHD vs IDO-ISOMETER

Parameters	Dominant	Non-dominant
N	90	90
HHD mean in kg (SD)	12.7 (4.9)	12.2 (4.8)
ISO mean in kg (SD)	11.3 (4.6)	10.8 (4.5)
M1-M2: Meandiff.	1.3	1.1
ICC_Agreement (95% CI)	0.82 (0.73; 0.87)	0.82 (0.74; 0.87)
ICC_consistency (95% CI)	0.90 (0.85; 0.93)	0.90 (0.85; 0.93)

N= number of subjects; HHD= Handheld Dynamometer; ISO= IDO-ISOMETER; SD = standard deviation; M2 = second measurement; Meandiff = difference of the mean; SDdiff. = Difference of SD; ICC = intra-class correlation coefficient; CI = confidence interval.

Table IV. — Intra-rater reliability IDO-Isometer.

Parameters	Dominant	Non-dominant
N	41	41
M1 mean in kg (SD)	11.9 (3.9)	11.2 (4.0)
M2 mean in kg (SD)	12.3 (4.1)	11.8 (4.4)
M1-M2: Meandiff.	-0.4	-0.6
ICC_Agreement (95% CI)	0.89 (0.81; 0.94)	0.85 (0.73; 0.91)
ICC_consistency (95% CI)	0.95 (0.90; 0.97)	0.92 (0.85; 0.96)

N= number of subjects; M1: first measurement; SD = standard deviation; M2 = second measurement; Meandiff = difference of the mean; SDdiff. = Difference of SD; ICC = intra-class correlation coefficient; CI = confidence interval.

Table V. — Inter-rater reliability IDO-Isometer.

Parameters	Dominant	Non-dominant
N	90	90
M1 mean in kg (SD)	11.3 (4.6)	10.8 (4.5)
M2 mean in kg (SD)	12.4 (4.8)	12.0 (4.8)
M1-M2: Meandiff.	-1.1	-1.2
ICC_Agreement (95% CI)	0.94 (0.91; 0.96)	0.92 (0.88; 0.95)
ICC_consistency (95% CI)	0.97 (0.95; 0.98)	0.96 (0.94; 0.97)

N= number of subjects; M1: first measurement; SD = standard deviation; M2 = second measurement; Meandiff = difference of the mean; SDdiff. = Difference of SD; ICC = intra-class correlation coefficient; CI = confidence interval.

Based on the intraclass correlation coefficient (ICC), the IDO-Isometer demonstrated excellent agreement with MicroFET 2 hand-held dynamometer (HHD) and can be considered a valid alternative for clinical research use[8].

Measurement differences between devices should be acknowledged. The HHD records peak forse during a self-selected maximal effort interval (3 seconds in this protocol), while the IDO-Isometer calculates the mean

force over the same duration of sustained contraction. These differing outputs may influence force interpretation, particularly when small fluctuations occur.

Secondarily an important benefit of the IDO-Isometer is the purchase price. Given that the HHD is a relatively expensive device with a price of a minimum of 990 euro (based on the Micro-Fet 2 used in this study), the IDO-Isometer can be considered as a cheaper but valuable alternative with a cost of 346 euro.

The testing configurations also diverge: the IDO-Isometer string is anchored to a fixed metal bar, which offers the operator a clear visual overview of the subject's postioning and form, allowing compensatory movements to be more readily detected. In contrast, the HHD relies heavily on the examiner's own counterforce capacity.

Regarding the range of measurement, the HHD is capable of recording forces up to 135 kg, well above physiological maxima, whereas the IDO-Isometer is limited to 21 kg. Only a few healthy participants in this study exceeded that higher threshold, and since external rotation weakness, especially in posterosuperior cuff pathology, is more typical in clinical populations, this range limitation is unlikely to be a practical constraint.

As hypothesized by Balcells et al., male participants exhibited significantly higher external rotation torque compared to females[10]. This findings corresponds with established biomechanical principles and reinforces the importance of sex-specific normative data. Some male participants demonstrated excessive compensatory shoulder flexion via biceps activation, highlighting the need for careful supervision during testing.

CONCLUSION

The IDO-Isometer demonstrated excellent reliability for measuring isometric external rotation at 90° shoulder abduction. Given its lower cost and ease of use, it may represent a valuable alternative to the HHD in both clinical and research settings.

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