A systematic review of the analytical approaches and methodological quality of studies evaluating the measurement properties of Dartfish (video-based) two-dimensional movement analysis.

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KEY FINDINGS

- *Dartfish can provide reliable and valid movement kinematic indicators describing simple uniplanar movements; complex movements pose more challenges.*
- *Particular effort should be taken on quantifying the dynamic or multi-planar movement using Dartfish.*

Background

- The barriers to using 3D motion analysis in real world contexts lead some to develop video-based solutions to measuring movement[1].
- It is important to evaluate the psychometric properties of 2D motion analysis enabling researchers to measure movement in different populations without the limitations of a strict laboratory setting[2,3]

Objective

- The purpose of this systematic review was to describe the contexts in which Dartfish psychometrics has been evaluated, critically appraise the methodological quality of the studies, and synthesize the psychometric properties reported.

Methods

Search Strategy
Key words: (2 –d motion analysis OR Dartfish OR video motion analysis) AND (reliability OR validity OR psychometric OR responsiveness OR MDC)
Dates: January 1999 to Dec 2018
Other: Google searches and hand searches of retrieved study references lists

Located citations (n = 1245):
Embase (n = 710)
Medline (n = 250)
PsycInfo (n = 266)
CINAHL (n= 19)

Title/Abstract review (n = 1245)

Articles accepted for full-text review (n = 68)
Embase (n = 24)
Medline (n = 29)
PsycInfo (n = 9)
CINAHL (n = 6)

Excluded at abstract review (n=1177)
Embase (n = 686)
Medline (n = 221)
PsycInfo (n = 257)
CINAHL (n = 13)

Included for Full-text critical appraisal With hand search (n=21)

Excluded at full text review and duplicate testing (n = 46)

Full-text review Criteria:
Inclusion:
1. One of the movements must have been measured using Dartfish software.
2. The purpose and analyses must have addressed at least one psychometric property.

Exclusion:
1. Studies using Dartfish for non-measurement research questions
2. Range of movement has not been analyzed with Dartfish.

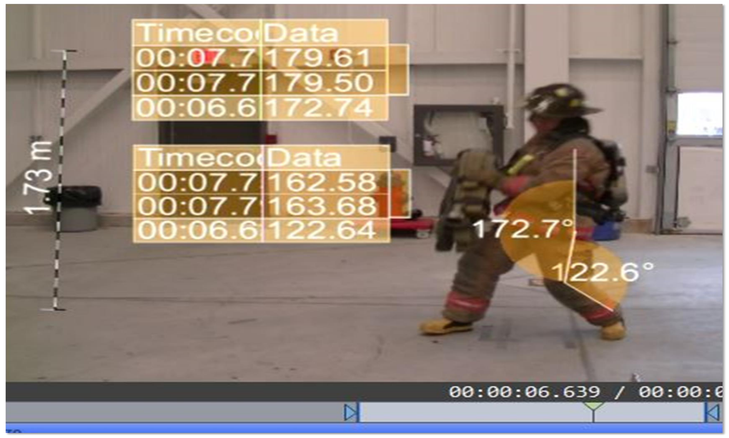
Results

Author, Publication Year	Population Movement studied	Sample Size	Mean Age Years ± SD (range)	Interest variable	Camera Position (2D)	Measurement Property Assessed	Quality score
Stensrud et al., 2011	Healthy female **SLS,SLVDJ,VDJ**	184	22±4	Angle	Frontal	Test-retest reliability ICC 0.57-0.89	63
Bart Dingenen et al., 2013	Healthy female **LTM,SLS,SLDVJ**	15	21.1±3.4	Angle	Frontal	Intra-rater reliability ICC 0.98-0.99	77
Junya et al., 2015	Spinal deformity patients **Walking**	40	60.1	Angle	Sagittal	Concurrent validity DARTFISH vs SVA r=-0.642 DARTFISH vs X-ray r=0.742	32
Andrew Miller et al., 2008	Healthy **Step-up, SLVDJ, Single-leg spring**	24	23.7 (21.2–26.3)	Angle	Sagittal	Test-retest reliability ICC 0.64-0.75	71
Beth S Norris et al., 2011	Healthy female **Mechanical lift task**	15	21~39	Angle	Sagittal	Intra-rater ICC 0.98-0.99 Inter-rater ICC 0.91-0.98 Test-retest ICC 0.79 & 0.91	92
Jennifer N et al., 2015	Healthy Runners **Treadmill running**	24	19.9±1.3	Angle	Frontal	Intra-rater reliability ICC 0.95-0.98	86
Constance M. Mier et al., 2011	Healthy **SR, PSLR**	60	25.0±9.3 M 23.7±7.9 F	Angle	NA	Intra-rater ICC 0.99 Test-retest ICC 0.79-0.99	88
Kathryn E Sinden et al., 2016	Firefighters **Firefighting high-rise lifting task**	12	40.5±8.3	Angle, Distance	Frontal Sagittal	Intra-rater ICC 0.72-0.97	88
Islam Mahmoud et al., 2015	Healthy children **Vertical jump**	38	(3 – 12)	Distance	Sagittal	Internal consistency Cronbach's alpha=0.953 Concurrent validity R2=0.85	41
S. Borel et al., 2011	Children with spastic cerebral palsy **Gait**	12	8.9	Angle, Distance Time	Frontal Sagittal	Cohen kappa(95%CI) 0.81 (0.509–1.109)	50
Justin C. Paul et al., 2015	Healthy **Walking** **Lower extremity: Rotation, forward, left and right side bend**	10	24.5±2.4 (23~30)	Angle Distance	Sagittal	Inter-rater reliability ICC 0.71-.97 MDC Angle: 2° ~12.6° Distance: 2.5~4.8 cm	55
Christopher Melton et al., 2011	Healthy + Shoulder injured **AE, AAE**	21	27 ± 6 H 29 ± 9 S	Angle Velocity	Sagittal	Inter-rater reliability Angle ICC 0.70-0.99 Velocity ICC 0.52	68
Constance M. Mier et al., 2013	Healthy **SR**	30	25.6 ± 7.6 M 22.4 ± 2.2 F	Angle	Sagittal	Intra-rater ICC 0.87-0.97 Inter-rater ICC 0.82-0.97 Test-retest ICC 0.84-0.97 Internal consistency ICC 0.95-0.99	79
François Fourchet et al., 2012	Male athlete **Flexibility of eight lower limb muscle groups**	10	15.3 ± 1.6	Angle	Sagittal Overlook	Reliability ICC 0.51-0.93	75
Leenesh Khadilkar et al., 2014	Healthy **ADL**	10	29 ± 5	Angle	Coronal Sagittal	Inter-rater ICC 0.68-1.00 Test-retest ICC 0.45-0.94	75
Caria N. et al., 2013	Healthy **VDJ**	16	25.5 ± 2.0	Angle Distance	Frontal	ICC-intra=0.95& 0.96 ICC-inter=0.82& 0.86	63
Y. NAGANO et al., 2008	Healthy female **Treadmill running**	28	21 ± 1	Angle	Frontal	Concurrent Validity R2 0.34-0.41	79
Richard B. Souza et al., 2015	Healthy **Propelling wheelchair**	256	42.3 ± 10.9(17-80) M 41.9 ±9.7(20-65) F	Angle	Back	Intra-rater ICC 0.81-0.95 Inter-rater ICC 0.88-0.93	79
Redler et al., 2016	Athlete participant Professional observers	267	14.5 (11~17)	Distance	Frontal	Inter-rater κ = 0.92 Intra-rater κ = 0.55	82
Milgrom et al., 2016	Spinal cord injury and ambidextrous	5	N/A	Angle Distance	Frontal	Concurrent validity ICC 0.47-0.95	71
S. Paul et al., 2016	Healthy People with Parkinson disease **STS,Single leg stance;** **Acutely induced dizziness**	45	Healthy 26.5 (4.3) 67.3 (7.1) PD 71.0 (7.1)	Angle Distance Time	Front Sagittal	Criterion validity ICC 0.59-0.99 Cohen's kappa: 0.95 & 1.00 Test-retest 0.98-1.00 Inter-rater 0.61-1.00	80

SLS: Single leg squat; SLVDJ: single-leg vertical drop jump; **VDJ**: two-leg vertical drop jump; **LTM**: lateral trunk motion; **SR:** test: sit-and-reach; **PSLR**: Passive Straight-Leg Raise Test; **SLR:** Straight-Leg Raise Test; **AE**: active elevation(Shoulder); **AAE**: active assisted elevation(Shoulder); **ADL**: Activity of daily living tasks; PR: Push and Release task; **STS**: Sit-to-stand;

Conclusion

- About 14% of studies had substantial methodologic flaws (quality <50%).
- Studies varied on movements studied (with less focus on the upper limb), indicators extracted (angles most used) and reference standard.
- Dartfish can provide reliable and valid kinematic data for lower extremity uniplanar motion; complex movement have more measurement error.



Discussion

- Dartfish has potential to enhance mobility assessments that physical therapists perform in a variety of clinical and real-world contexts.
- An important concern in 2D analysis is perspective error, strategies to mitigate this error require more attention.
- Upper extremity protocols are insufficiently defined.

Reference

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Acknowledgements: This work was funded by the Canadian Institutes for Health Research (FRN: 114112). JCM is supported by a CIHR Chair in Gender, Work and Health and the Dr. James Roth Research Chair in Musculoskeletal Measurement and Knowledge Translation.