

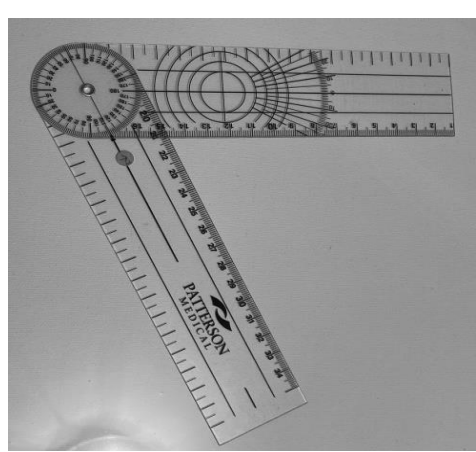
# A Pilot study to compare the accuracy of two goniometry tools used to assess forearm rotation range of motion and Motion Analysis.

## BACKGROUND

- Forearm rotation is an indispensable movement for upper limb function.
- It's goniometric assessment within clinical practice varies.
- The pilot study aimed to compare the accuracy of 2 goniometric tools to the anatomical range of motion analysis.
- Also, to inform a full scale study with an injured population.

## METHODS

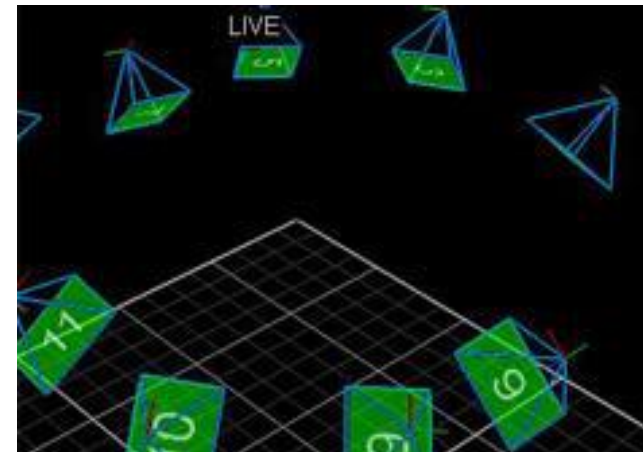
- The Quasi-experimental within-participant design compared the active ROM, in degrees of motion, of the Universal Goniometer, a handheld Inclinator and a 3D Motion analysis system (VICON).



Universal Goniometer (UG)



Inclinometer



VICON

- Following a G-Power calculation -21 Healthy Subjects were recruited from the Cardiff University School of Occupational Therapy. University ethics was obtained.

### 3. Data collection:

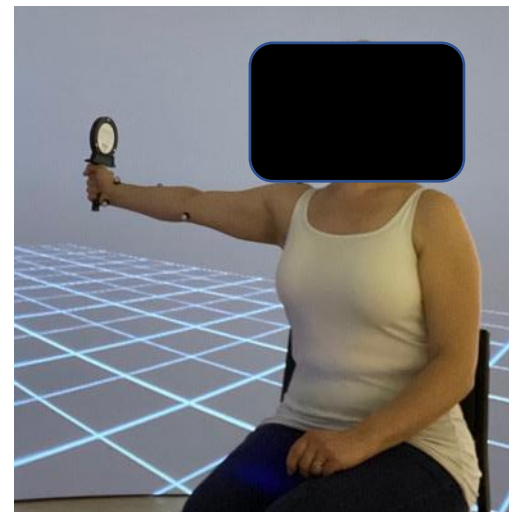
#### Goniometry Trials:

- 3 non-randomized assessments were taken from each tool (in degrees), by a single assessor.

#### Motion Analysis - 6 Degrees of Freedom:

- The reflective markers created rigid reference points of the arm/hand
- to identify joint co-ordinates
- to allow interpretation of the Vicon data.

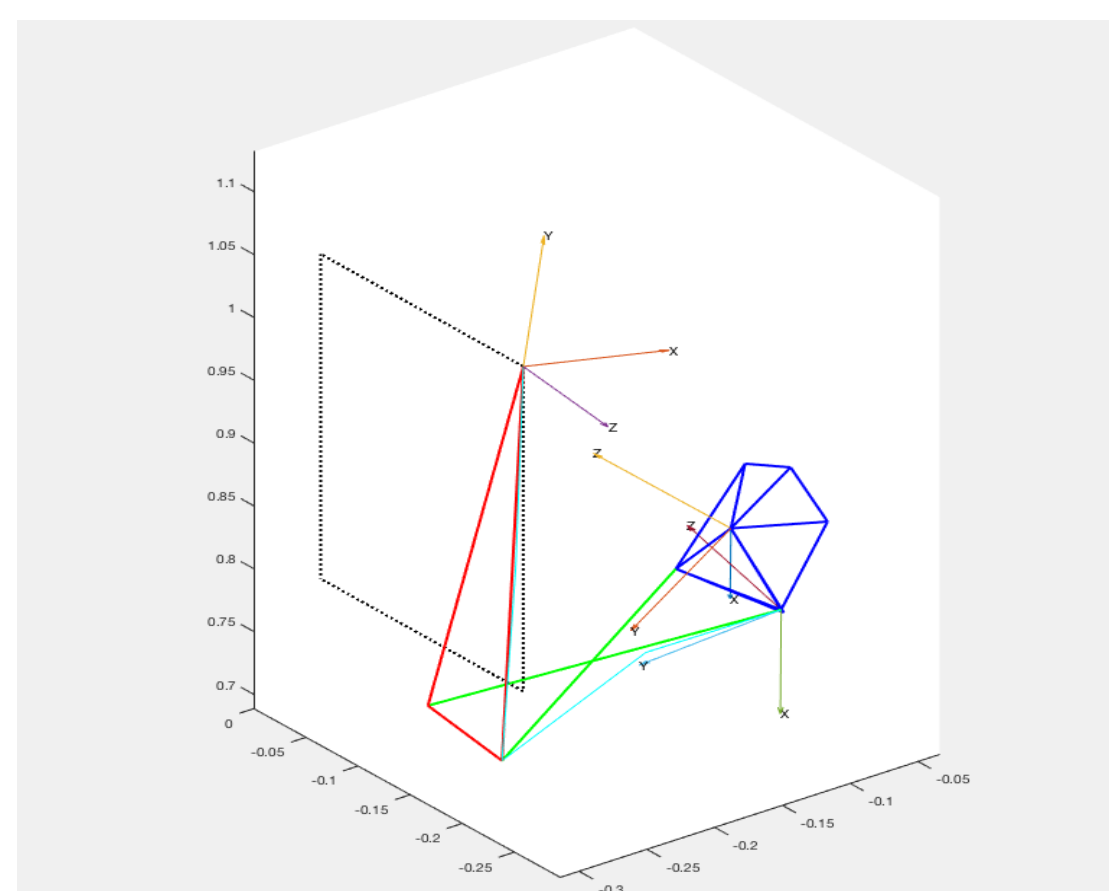
- A starting 'T Pose' was required to visualise all of the markers to the 12 infrared Vicon camera's.



T pose	to ensure all 12 markers were visible and no reflective clothing
Hand held	<ul style="list-style-type: none"> <li>Pronation HP01, HP02, HP03</li> <li>Supination HS01, HS02, HS03</li> </ul>
Universal Goniometer	<ul style="list-style-type: none"> <li>Pronation UP01, UP02, UP03</li> <li>Supination US01, US02, US03</li> </ul>

Order of trials

- The Vicon data was exported into MatLab (R2019b) software using a local co ordinate system to produce degrees of motion.



Local co-ordinate system

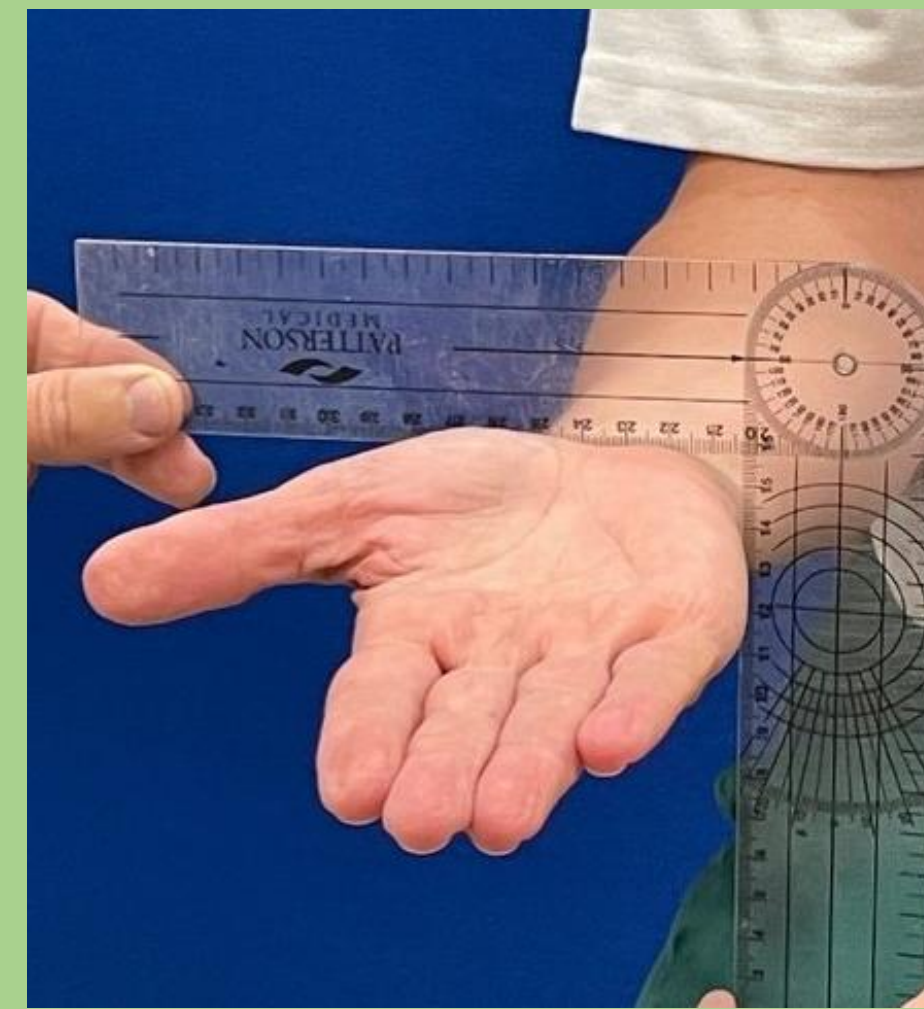
- Mean measurements from each goniometer were compared to each other and the Motion analysis anatomical ROM.

- Statistical analysis was performed using SPSS (version 25) software, utilizing a paired sample t-test.

AUTHOR: Helen Taylor



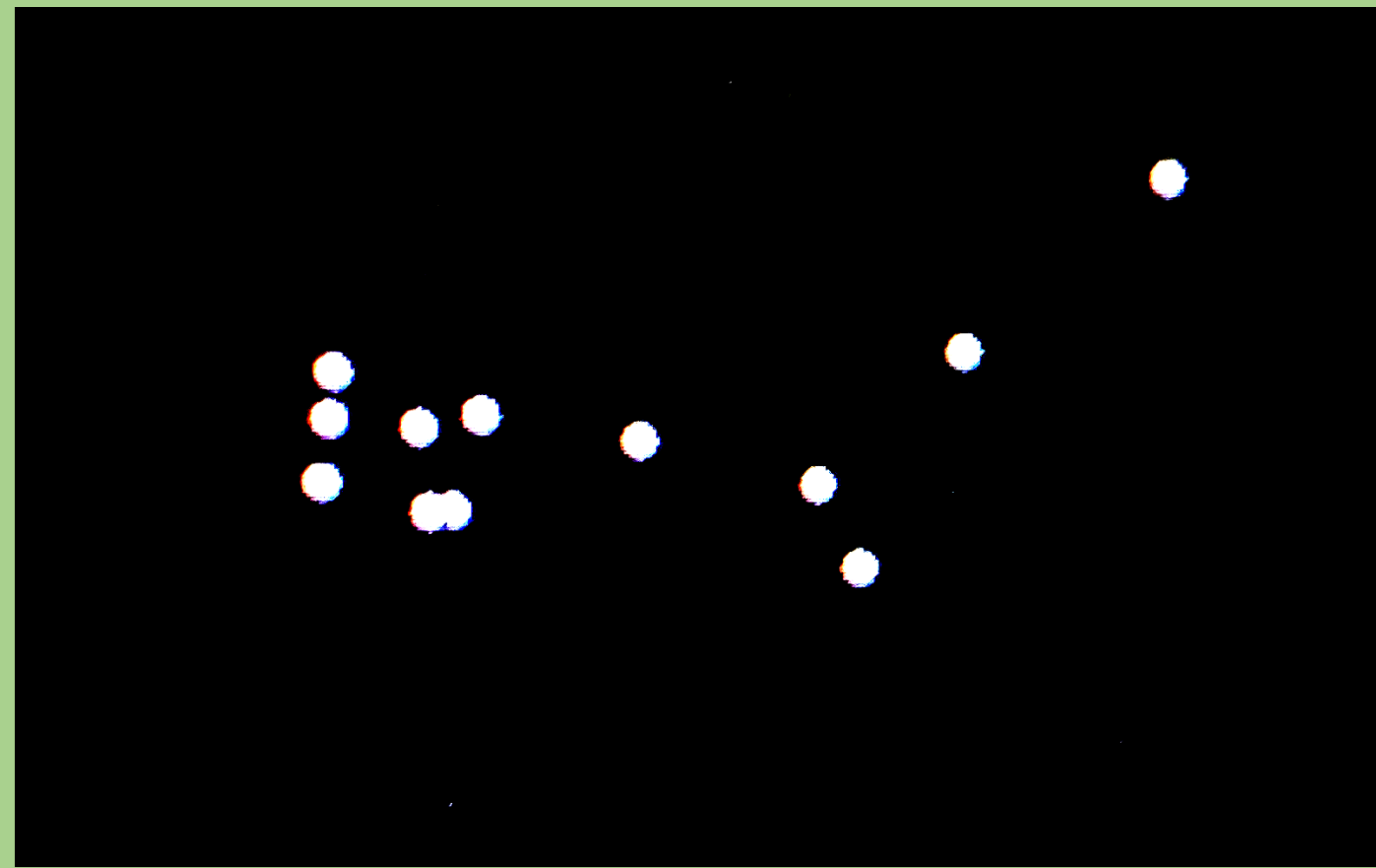
Baseline Inclinator



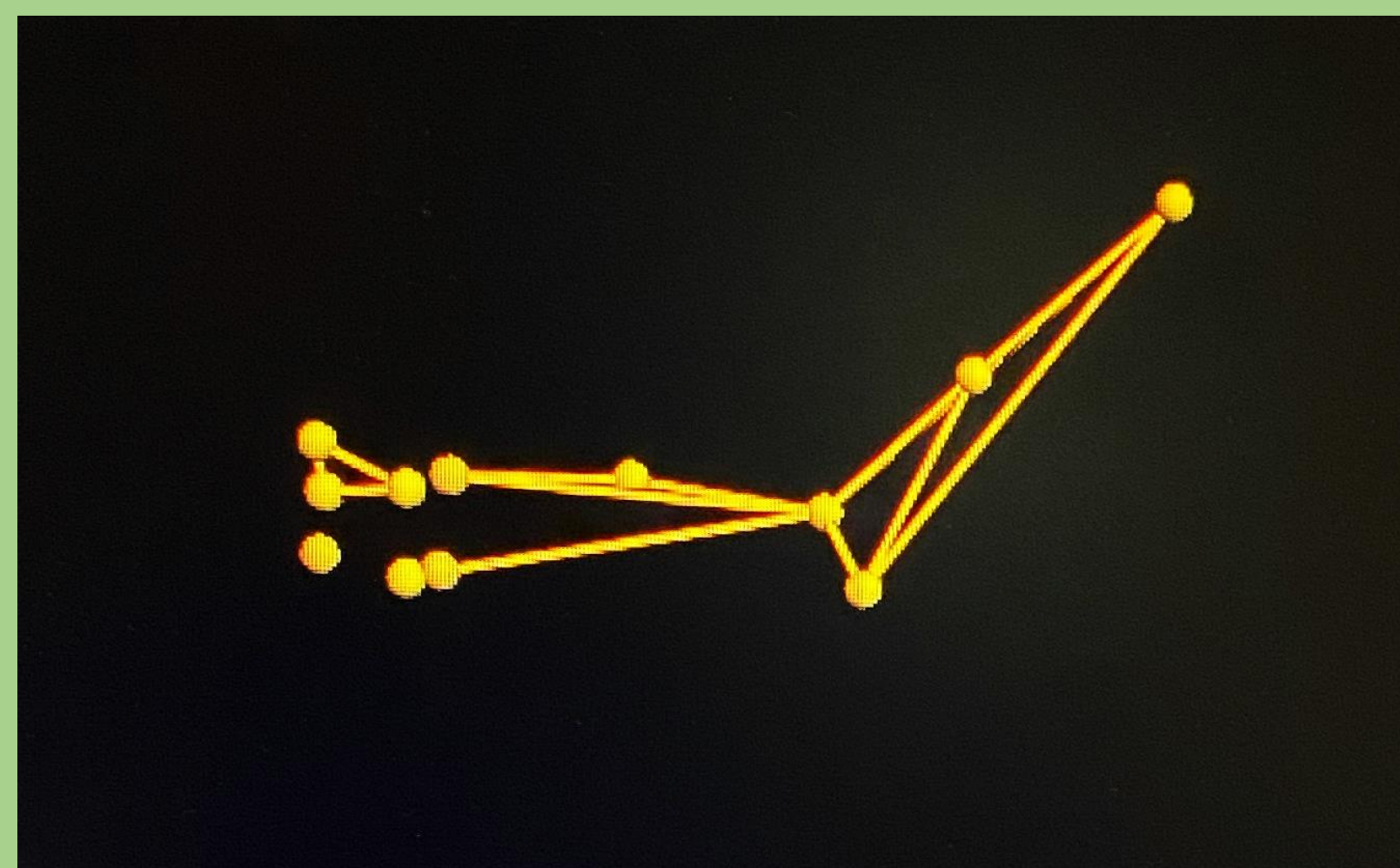
Universal Goniometer



Reflective markers



Markers visible to Motion capture cameras



Markers once labelled and segments identified

## Marker locations:

- Glenohumeral joint
- Medial and Lateral Epicondyles
- Radial and Ulna heads
- Base of 3<sup>rd</sup> Metacarpal
- Heads of 2<sup>nd</sup>, 3<sup>rd</sup> and 5<sup>th</sup> Metacarpals
- Pisiform
- Mid Humerus
- Mid forearm

## RESULTS

### Descriptive statistics:

Trial (Mean)	N	Range	Minimum	Maximum	Mean	Std. Deviation
Vicon (Handheld Inclinator) Pronation	21	39.09	46.74	85.83	75.78	9.23
Handheld Inclinator Pronation	21	28.33	61.67	90.00	82.22	6.89
Vicon (Handheld Inclinator) Supination	21	32.96	41.27	74.23	56.42	9.48
Handheld Inclinator Supination	21	40.67	66.00	106.67	86.22	6.70
Vicon (UG) Pronation	21	34.48	50.78	85.26	75.23	9.02
UG pronation	21	24.00	66.67	90.67	80.52	7.23
Vicon (UG) supination	21	29.69	49.35	79.04	64.09	8.35
UG supination	21	36.67	63.33	100.00	85.62	7.37

### Paired Trial Significance:

Paired Trial	Effect Size Supination	Effect Size Pronation
Vicon and UG	2.73	0.65
Vicon and Inclinator	3.63	0.79
UG and Inclinator	0.09	0.24

- The consistent underestimation of Vicon questions its ability to accurately measure forearm pronation/supination using the methods or calibration used within this study.
- No clinical difference was found between the tools so, it is not possible to recommend one tool over the other.

### Limitations:

- Number of marker drop outs- impact on data and results.
- Number of Outliers - either due to small sample size or methodological issues.
- Single assessor - potential individual tester bias.

### Strengths:

- This research adds to the sparse literature in the use of motion analysis of forearm rotation.

The motion analysis data significantly underestimates the goniometric tools with greater inaccuracy in Supination.

Methodological or protocol changes are needed to improve accuracy in this particular ROM for any further study.

There was no meaningful difference between the two goniometric tools.



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