



University of  
**Strathclyde**  
Engineering

# Designer Relevant Biomechanical Data: package opening in an older adult population

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# Introduction and Background

- Biomechanical research is producing valuable data relating to the strength and mobility of the older generation and how they interact with products.
- Requirements of the older generation are frequently not being met in the design of everyday products.
- Designers are not aware that the data exists.
- The data is presented in a format that designers find difficult to understand and use.
- Data produced from biomechanical testing does not match the requirements of product designers.

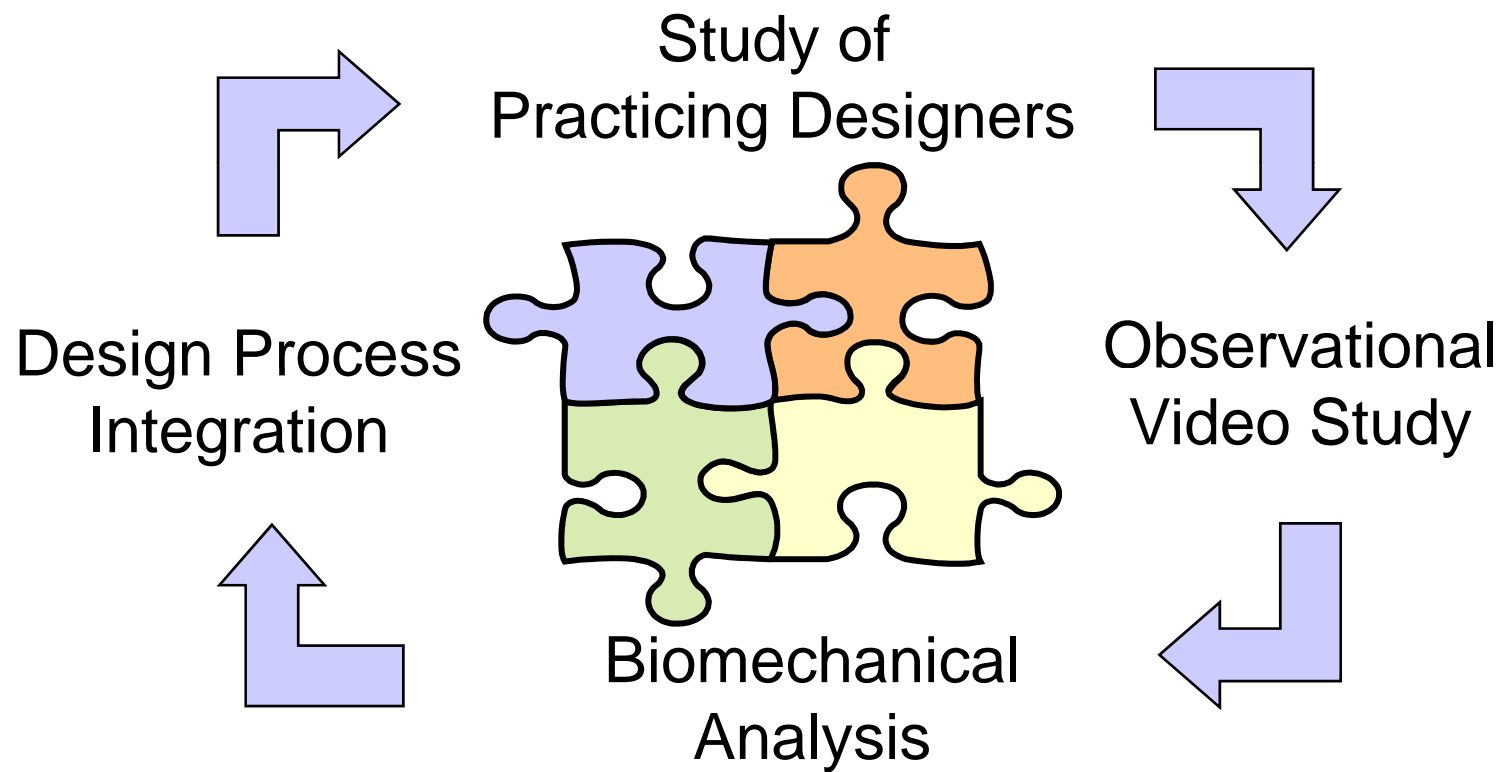


# Aim

The main aim of this research was to facilitate both product designers and bioengineers by ensuring that biomechanical tests match the requirements of product designers



# Methodology





# Survey of Designers

- Structured interviews were conducted with ten design companies involved in packaging design.
- Range of companies SME's through to large multinational
- Current design process and practices, common tools and techniques.
- What design criteria were more important to them
- Awareness, understanding, and use of ergonomic and biomechanical data.
- Understanding, and use of Inclusive Design.
- How older adults are currently considered in new designs
- Types of design data currently used and why



# Survey of Designers - Findings

- ‘Openability’ is not a major concern amongst the packaging designers did not rank in top 3 - packaging “appearance” consistently ranked top.
- Packaging designers knew what inclusive design was however, little evidence of it being put into practice
- Not currently a requirement of clients



# Survey of Designers - Findings

- There was very little evidence of ergonomic data being used regularly by packaging designers.
- Very few knew where they could access biomechanical data.
- Widespread adoption of user trials and focus groups (in most cases not including older adults)
- Older adults occasionally included in design process through consumer testing or informal discussion.



# Observational Study

Jars (tesco value pasta sauce, 440g)

Soft drinks bottle (irn-bru, 500ml)

Soft drinks can (irn-bru, 330ml)

Tin with ring pull (Heinz vegetable soup, 400g)

Child Resistant Medicine Bottle

Bleach bottle (original Domestos, 750ml)



40 subjects

4 age groups:

20-35(control)

60-70

70-80

80+

(gender balanced)



# Observational Study - Results

Observational study results characterise opening strategy

- Hand grip type
- Starting posture
- Opening motion

Results for soft drinks bottle are presented



# Observational Study - Results

Grip types used for bottle opening (frequency of occurrence indicated)



A. Inverted Power Grip  
(2/40)



B. Lateral Pinch Grip (digits I and III)  
(6/40)



C. Lateral Pinch Grip (digits I and II)  
(22/40)



D. Other  
(1/40)



E. Power Grip (palm + digits III and IV)  
(7/40)



F. Normal Power Grip  
(2/40)



# Observational Study - Results

Starting Posture and Opening Motion used for bottle opening

		LHS	RHS
<b>Posture</b>	Wrist	Extended	Ulnar deviated
	Elbow	-	-
	Shoulder	Internally rotated	Abducted + Internally rotated
<b>Motion</b>	Wrist	Flexion	Radial deviation
	Elbow	-	-
	Shoulder	Abduction	-



# Observational Study - Conclusions

- There were no clear differences in opening strategy used between the older adult age groups.
- Subjects and control group members often used a cup-shaped hand over the top of bottles and jars, grasping 2, 3 or 4 fingers together at once.
- Handedness did not necessarily determine the way in which the subjects gripped the packaging.
- There was limited evidence of those with HWA adopting different strategies for opening packaging.
- Holding both the jar and the bottle tilted at an angle made the opening task easier (Chang *et al.* 2008)



# Biomechanical Analysis

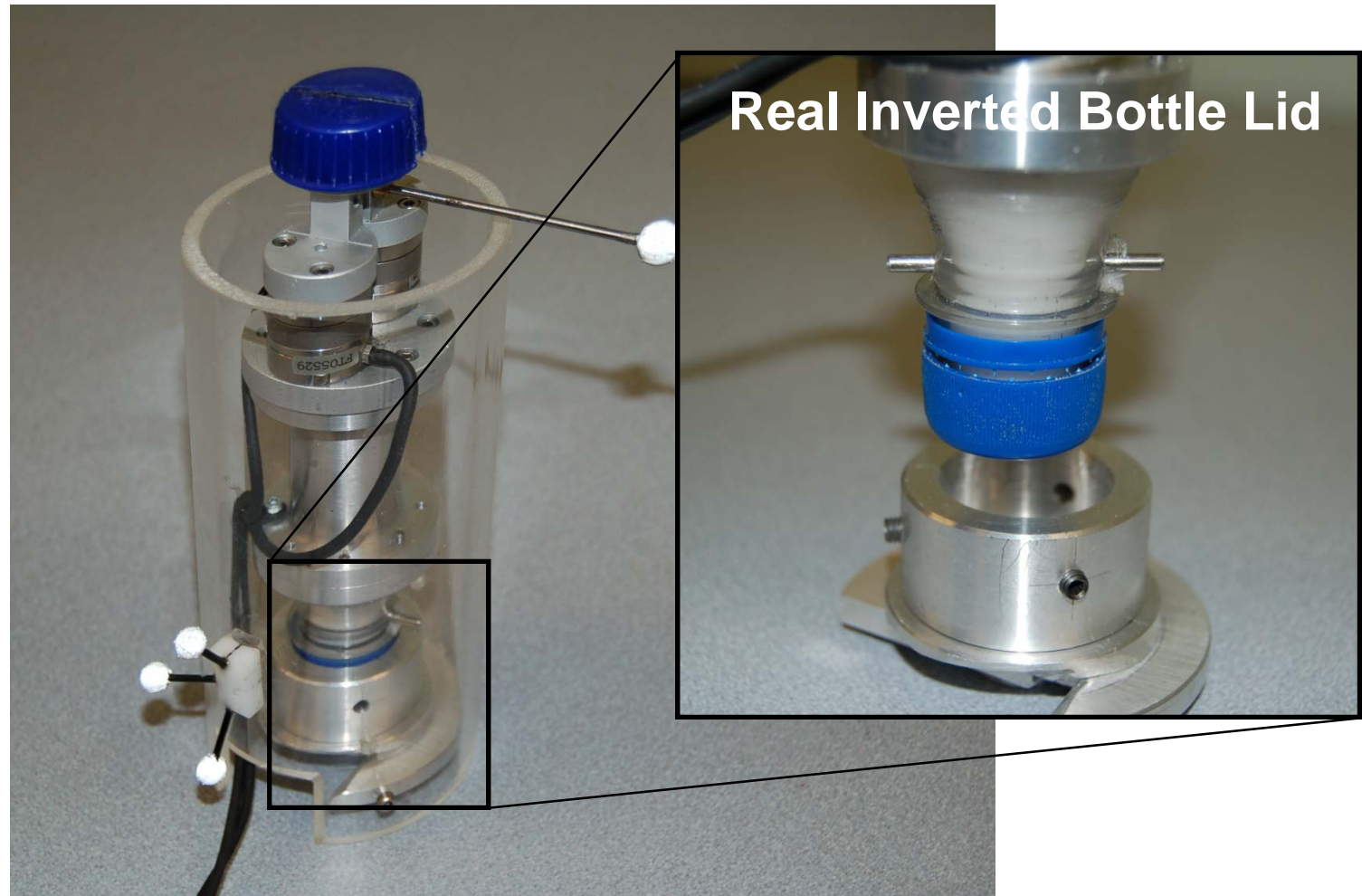


# Equipment – Jar Opening



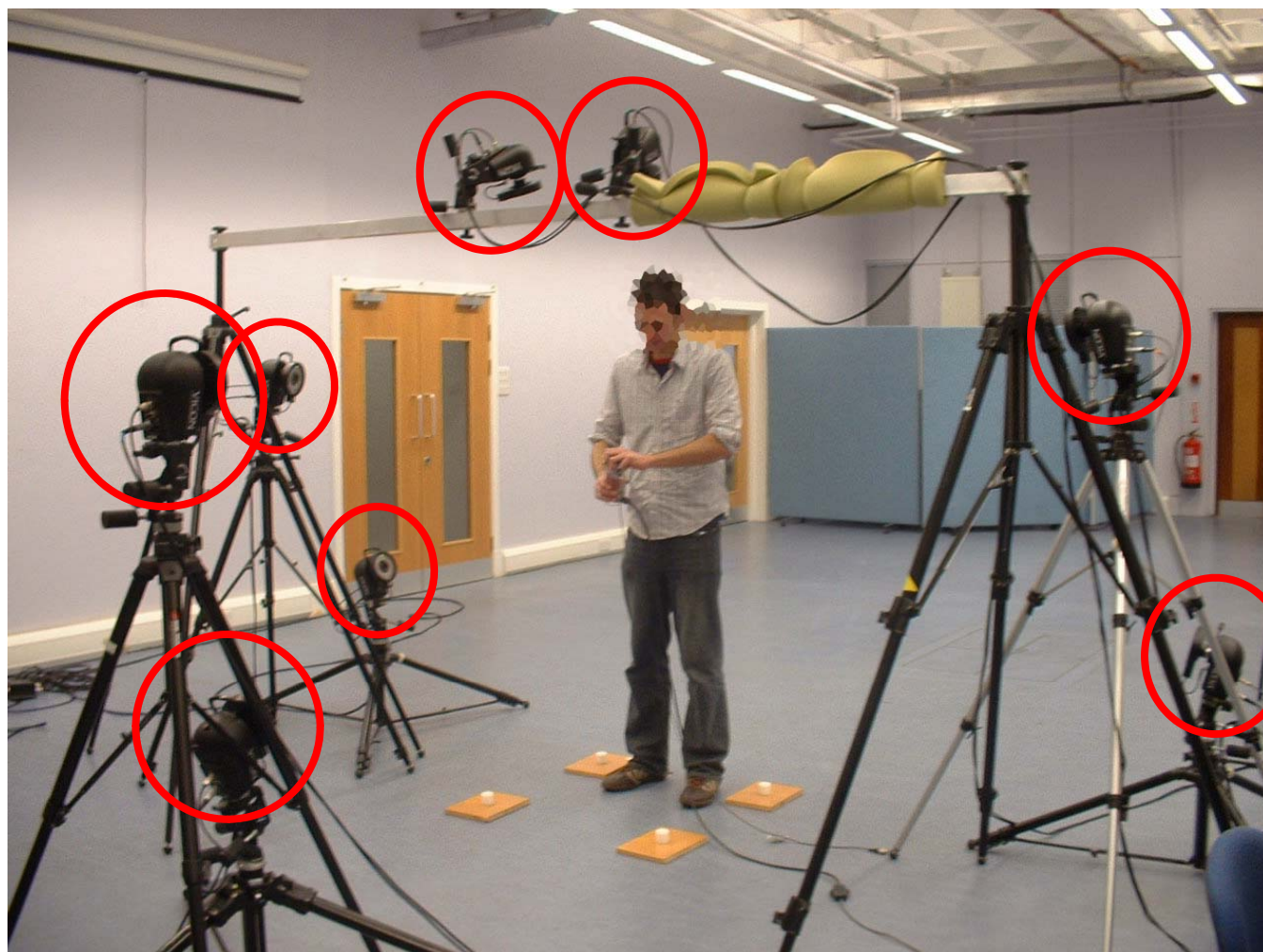


# Equipment – Bottle Opening



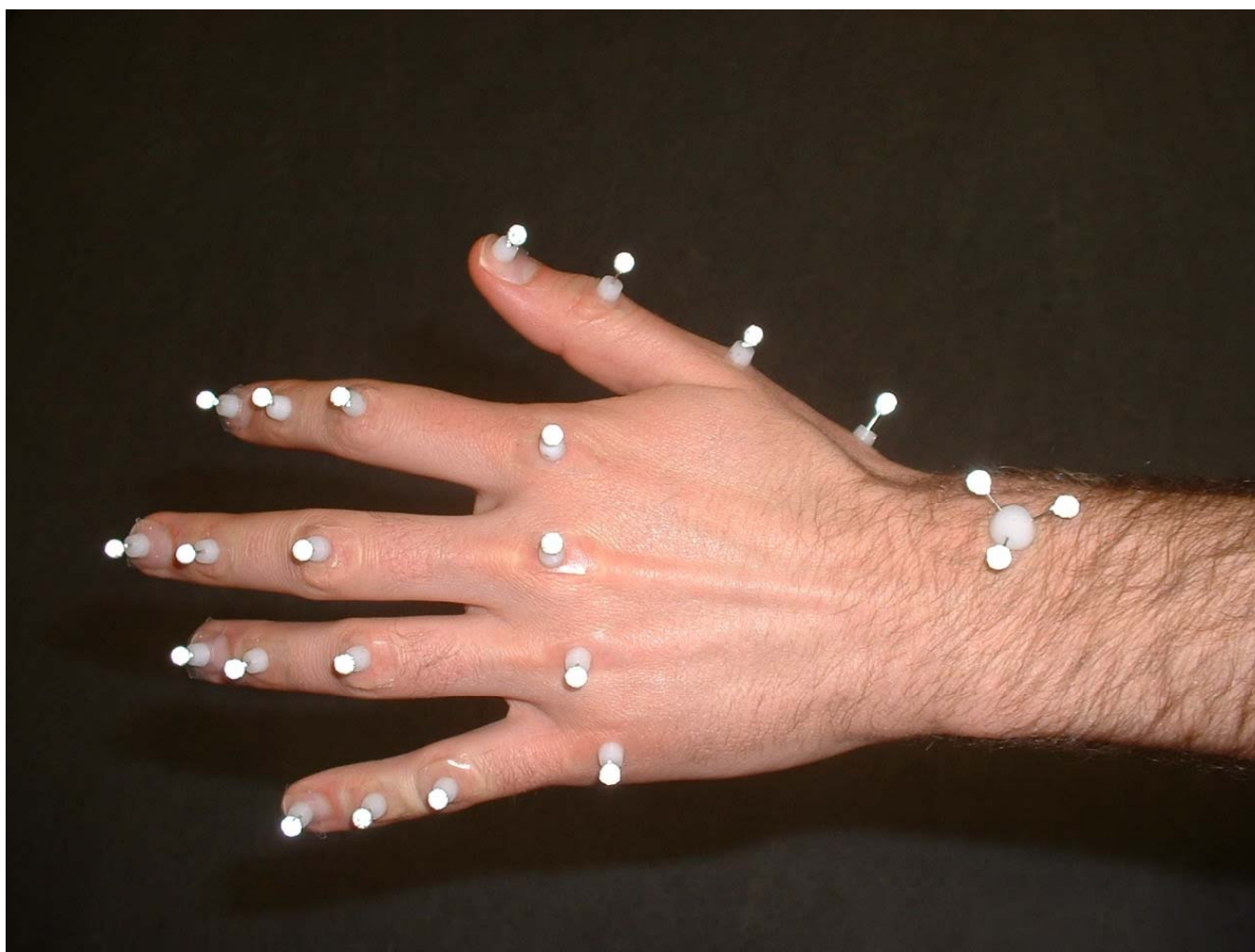


# Motion Analysis Cameras





# 50 Hand Markers



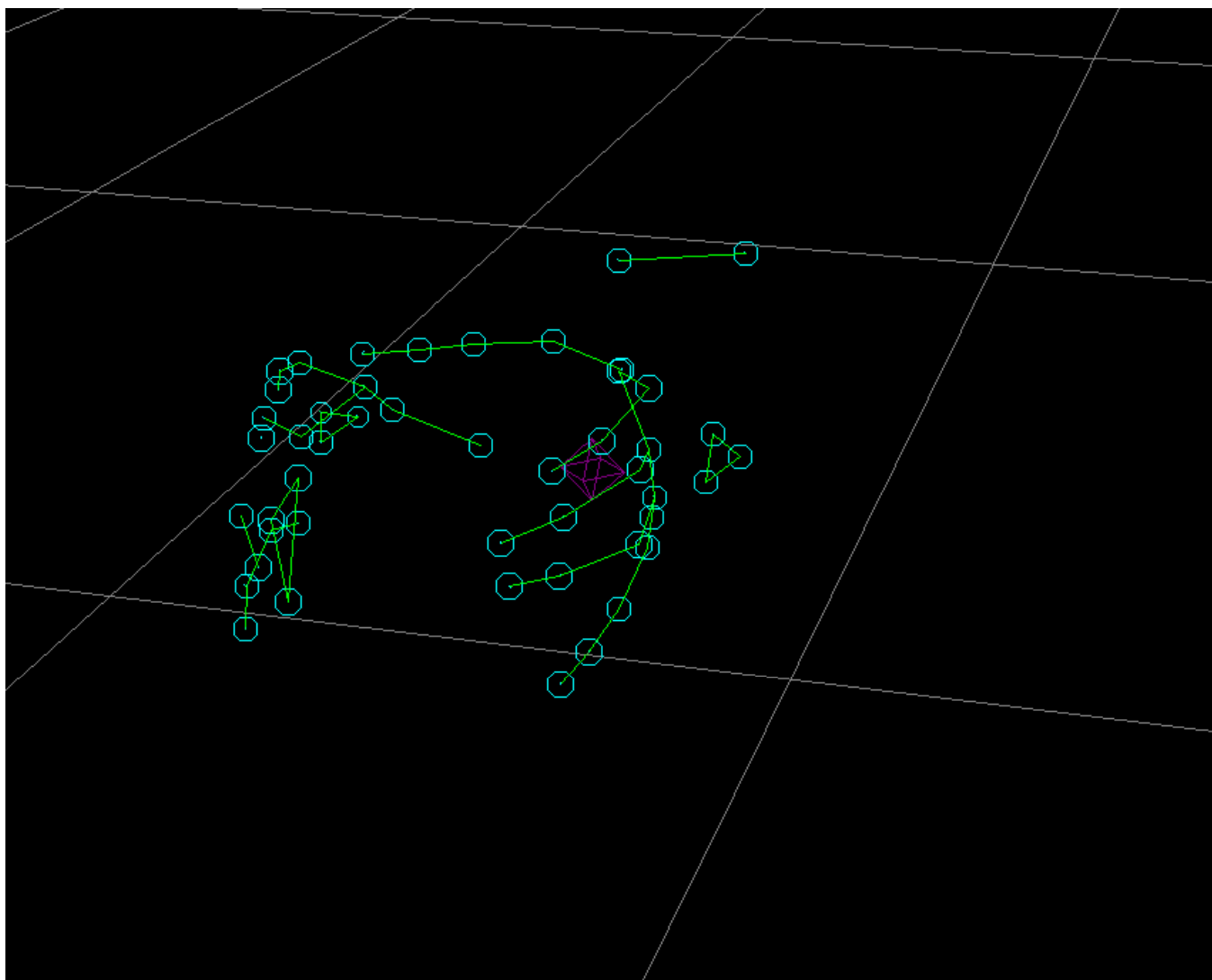


# Jar Opening with Video





# Jar Opening with Vicon





# Biomechanics Results

- Static joint angles – categorise grip types
- Joint motions – categorise opening styles
- Resultant forces and moments caused at key joint centres.

**Are there certain grip types or opening styles that minimise these resultant moments?**



# Designer Interview - Description

- Return to companies who participated in first interviews
- Presented with biomechanical data in different formats
- Video clips, screenshots/photos of handgrips, joint angles, resultant moments whilst opening packaging.
- Vicon video outputs and Vicon video alongside standard video.
- Data relating to pain and discomfort experienced whilst opening packaging.
- Novel methods for presenting data were also explored, including
- Virtual biomechanical testing
- Vicon video footage with normal video footage synchronised on top

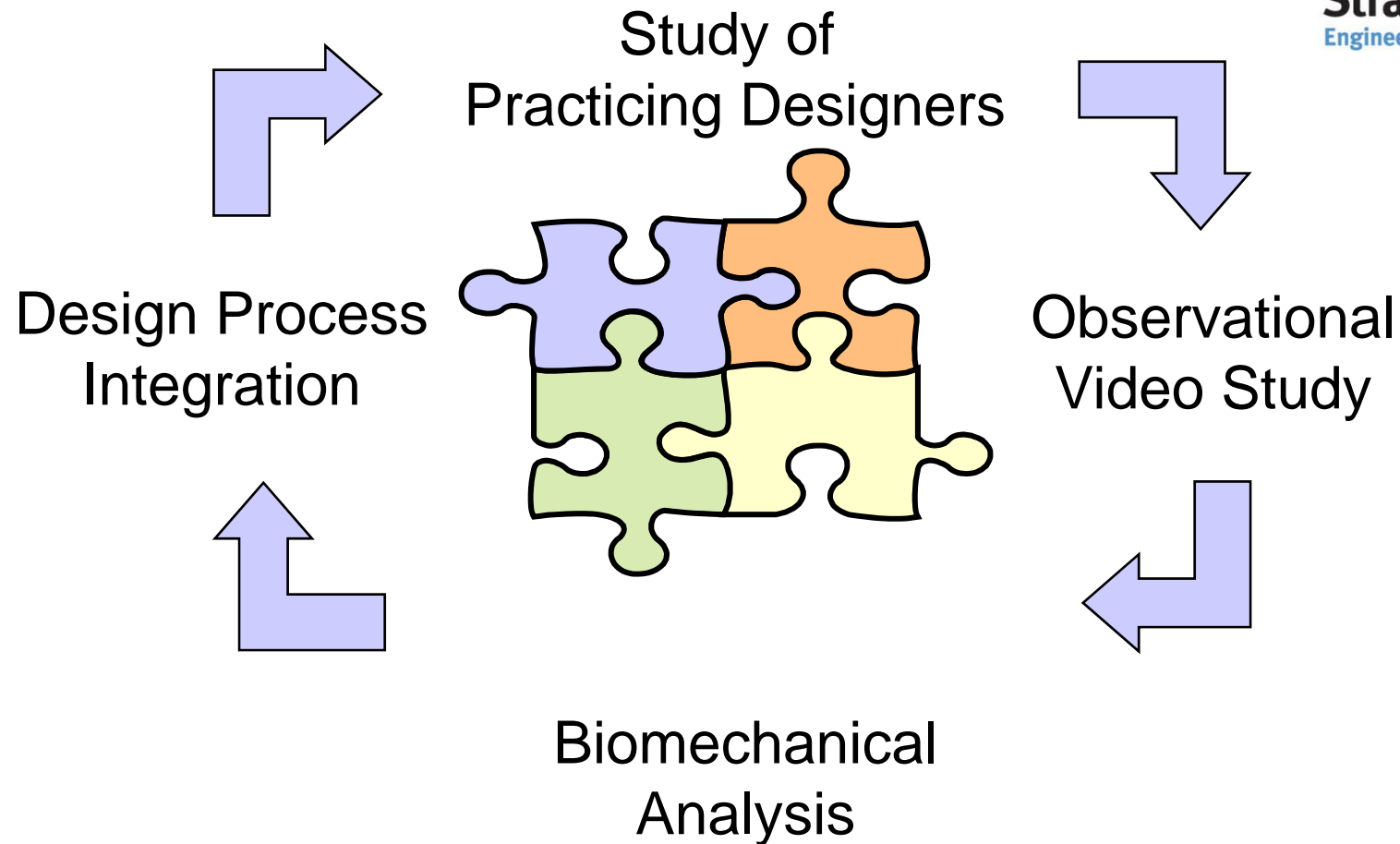
# Designer Interview - Description

- Novel methods for presenting data were also explored, including
- Virtual biomechanical testing
- Information on which muscle groups are being used at different points while interacting with packaging
- Vicon video footage with normal video footage synchronised on top
- The ability to assess the effects of changing various design variables
- A database of videos of users with various hand impairments interacting with packaging



# Designer Interview - Results

- Despite the high levels of precision offered by biomechanical testing, designers prefer traditional video data – lab based data is compromised.
- Vicon output screen found to be too clinical and dehumanising.
- Designers want to know more than the physical parameters of peoples abilities.
- Video aids interpretation of biomechanical results.
- In conclusion, the best way to present biomechanical data is with an introduction to biomechanics, clear conclusions from the tests, a full explanation of the results and test procedures used, and preferably synchronised video data.



- Methodology is a step towards closing the loop
- Framework for testing and verifying any product
- Client driven (in line with existing findings)

# Acknowledgements

- AG Barr
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- Subjects
- SPARC