ACQUISITION & ANALYSIS OF CUSTOMISED POSTURAL SUPPORT SYSTEMS- SHORT REPORT

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ABSTRACT

For 30 years or so specialists in wheelchair seating services in the developed world have captured many thousands of shapes (contours) in various forms for custom seating systems. The predominant methodology employs a plaster casting technique and as a result, shape information is often retained in the plaster cast, therefore has not been completely measured and may well not be recoverable over time due to storage issues. Consequently, little comparable measurement or outcome data is available which ultimately hinders any scientific evaluation from taking place. This work has developed digital shape acquisition and analysis processes to scientifically advance the knowledge of individuals' shapes with complex disabilities. Shape acquisition and analysis in the field of special seating has not been reported at the level of accuracy and resolution available with the use of laser scanners. The shape acquisition processes have employed 3D laser scanning technologies and hence have validated the use of the lower cost laser scanner (resolution 100µm) for both research purposes and clinical work utilizing CAD/CAM techniques. Shape analysis processes were devised by representing the shape volume (obtained from the scan data) as standardised geometric shapes (column rods) which allowed comparisons to be made. Using these geometric shape representations, a potential low-cost manufacturing technique was explored which could influence fabrication techniques for a proportion of shapes. For the remaining shapes, external CAD/CAM technologies could be sourced. This work has demonstrated that more affordable scanning technologies using a high resolution are possible to advance the routine clinical services and research within the field.

INTRODUCTION/ AIMS & OBJECTIVES

This work was carried out at the Rehabilitation Engineering Unit (REU) at the ABM University NHS Trust in Swansea. This special seating service is provided to 300+ clients in South West Wales with complex postural needs. This service utilizes a Microscribe G2LX/Microscan (Immersion Corp., San Jose, CA, USA) 3D laser scanner (Figure 1) to record the shape information (Figure 2), and an Isel FLATCOM 3 axis CNC (Computer Numerical Controlled) to form part of the Digital Seating Service to manufacture customized seating systems. This work is based on the processes developed and used by Peter Watson, Musgrove Park Hospital, Belfast.

Figure 1. Microscan laser scanner: Scanning in progress

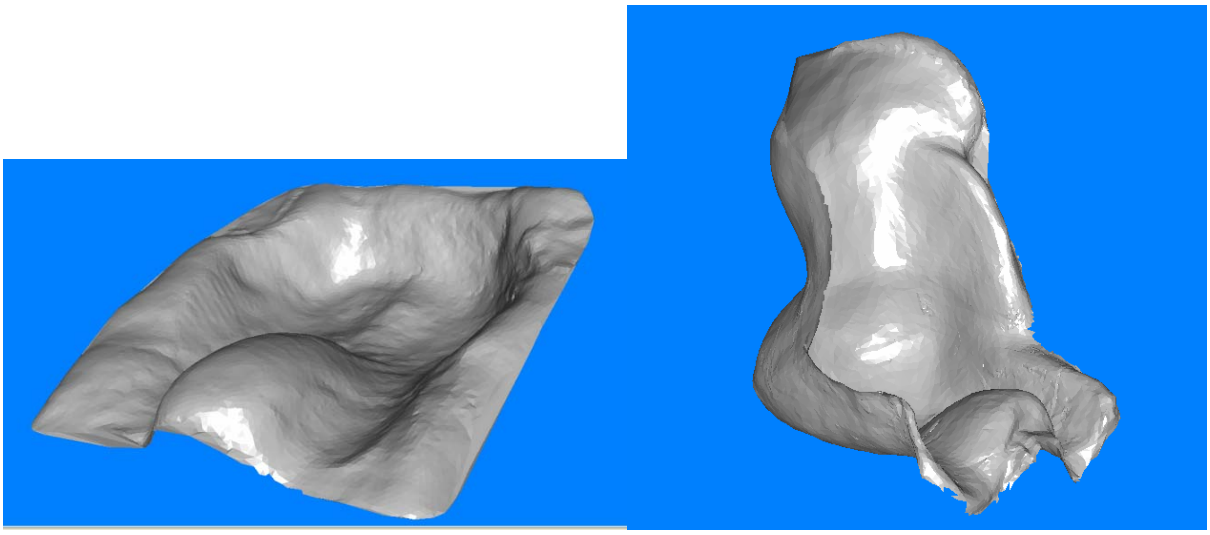

Figure 2. Processed Microscan images

The purpose of this study was to utilize scanning technologies to capture 3D information of customized support systems. A collection of 25 shapes from around the UK allowed quantitative shape analysis and comparisons to be made.

The primary aim of this study was to develop a technique for 3D shape data collection and analysis of custom seating systems, in order to develop a better understanding of human shape to influence fabrication techniques. To achieve this, shape acquisition and analysis techniques were reviewed to provide an overview of the current state of technology and research.

A secondary aim of the project was to investigate two shape acquisition technologies by scanning a selection of shapes by both methods. These scanning technologies were: the Faro ScanArm (FARO Technologies Inc., Florida, USA) (Figure 3), a high-cost industrial laser scanner providing 61µm resolution and the Microscan desktop laser scanner (Immersion Corp., San Jose, CA, USA) (Figure 1), providing a 100µm resolution. This investigation allowed recommendations to be made regarding the most appropriate scanning methodology and accuracy required for research purposes and CAD/CAM manufacturing of seating systems.

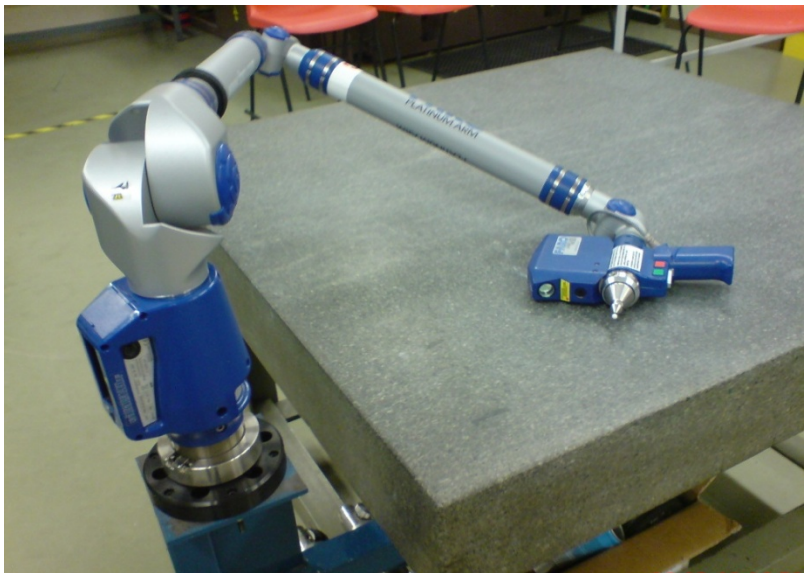

Figure 3. Faro Scan and scanning table

The research question for this study was: Can 50% of the customized support systems be represented (and manufactured) using standardized geometric shapes that are within ±10mm from the actual shape? This tolerance was selected on the basis of clinical judgment.

CONCLUSION

This study has developed shape acquisition and analysis processes to scientifically advance the knowledge of individuals' shapes with complex disabilities. The processes have employed 3D laser scanning technologies where results validated the use of the lower cost laser scanner for both research purposes and clinical work utilizing CAD/CAM techniques (e.g. a Digital Seating Service).

Shape analysis processes were devised by representing the shape volume as standardized geometric shapes (column rods). A potential low-cost manufacturing technique was explored using these geometric shape representations (as shown in Figure 4), which provided valuable results relating to the proportion of bases and backs which may be fabricated in this way, as described in Figure 5. These results suggest that small-scale manufacturers of customized seating systems may be able to fabricate their customized seating systems using the proposed

geometric representations for a certain proportion of the shapes which would be a low-cost technique. For the remaining proportion of shapes, external CNC technologies could be sourced which could be geographically central to several Special Seating Units.

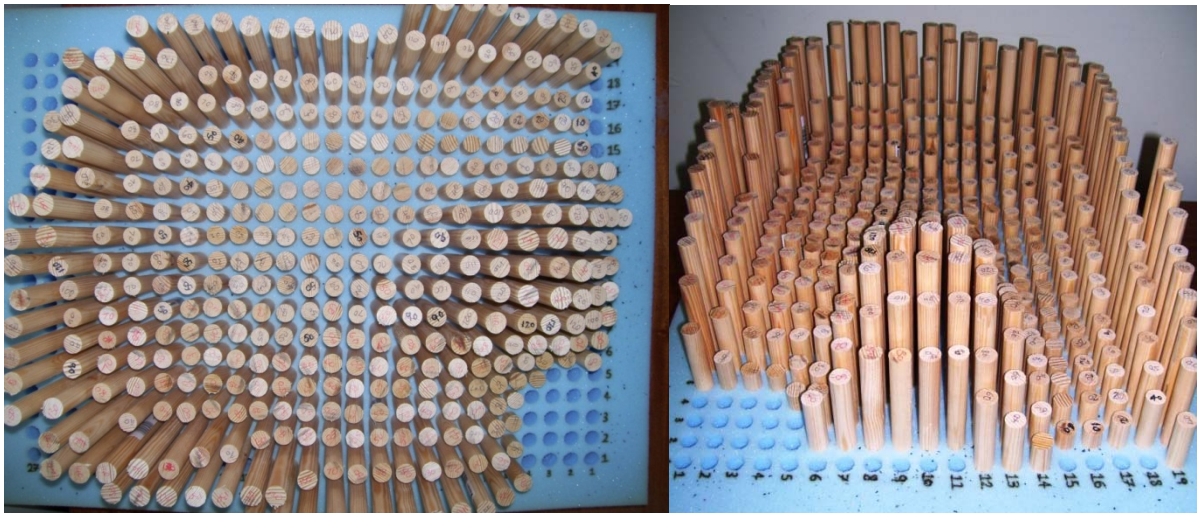

Figure 4. Dowel model representation for CH2base shape (adult)

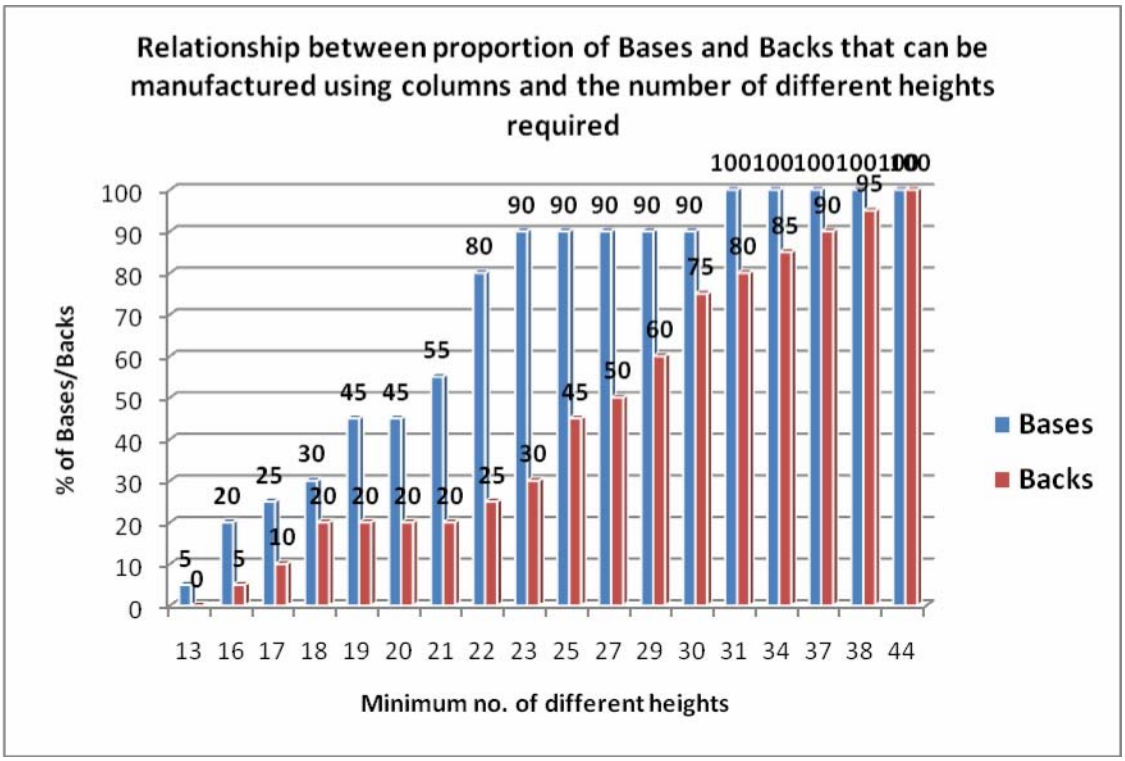

Figure 5. Graph showing the proportion of bases and backs which can be represented using 20mm x 20mm geometric columns

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