

1. ABOUT THE DATASET

Title: Dynamic acetabular cup orientation in fast and slow walking total hip replacement patients: raw motion data, processed cup angles and statistical analyses.

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Rights-holder: University of Leeds

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Description:

This dataset includes the input, raw output and processes data from a study investigating the orientation of the total hip replacement acetabular cup when implanted in the pelvis and during walking gait.

The associated project aimed to understand the variation in cup orientation during gait compared to its orientation within the pelvic bone on implantation. This work is motivated by the refinement of testing protocol for total hip replacement devices and the understanding of the implications of cup implantation position during surgery. Movement data are used from two sub-groups of patients, with faster and slower self-selected walking speeds post total hip replacement. And the statistical analysis looks for any differences between in the groups in terms of dynamic orientation of the acetabular cup. Correlation analysis is also included, which illustrates the relationship between pelvic orientation measurements and acetabular cup orientations. That provide information on which aspects of dynamic cup orientation can be predicted simply from single pelvic angles and which are a more complex combination of multiple angular orientations.

The data itself includes tabulated measurements from every stage of the analysis from the pelvic orientation angles, through the cup angles, to the high-level statistical outcomes.

Cite as:

Vasiljeva K, Lunn D, Chapman G, Redmond A, Wang L, Thompson J, Williams S, Wilcox RK, Jones AC (2024) 'Dynamic acetabular cup orientation in fast and slow walking total hip replacement patients: raw motion data, processed cup angles and statistical analyses.' University of Leeds. [Dataset] <https://doi.org/10.5518/1317>

Related publications & datasets:

- Report of this study Vasiljeva K, Lunn D, Chapman G, Redmond A, Wang L, Thompson J, Williams S, Wilcox RK, Jones AC. 'Dynamic acetabular cup orientation during gait: a study of fast and slow walking total hip replacement patients.' (In preparation.)
- Codes used in the data processing. Vasiljeva K. 'pelvic-acetabular-motion-convert', Python codes calculating acetabular cup orientation with pelvic motion angles. Zenodo data, 2021. doi.org/10.5281/zenodo.5846247.
- Key LifeLongJoints studies based on the wider cohort. Lunn DE, Chapman GJ, Redmond AC. 'Hip kinematics and kinetics in total hip replacement patients stratified by age and functional capacity.' J Biomech 2019;87:19-27.
- De Pieri E, Lunn DE, Chapman GJ, Rasmussen KP, Ferguson SJ, Redmond AC. 'Patient characteristics affect hip contact forces during gait.' Osteoarthritis Cartil 2019;27(6):895-905.
- LifeLongJoints project, protocol details and data collection. Lunn D, Chapman G, Redmond A. *Motion analysis in total hip replacement patients*. University of Leeds; 2019. <https://doi.org/10.5518/319>.

Ethical approval:

Ethical approval was obtained for the patient data collection within the LifeLongJoints project (IRAS 14/NE/1013) and all patients provided informed, written consent to participate in the study. All data was collected with the expressed aim of open release and re-use for further research.

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2. TERMS OF USE

Copyright 2024 University of Leeds. This dataset is licensed under a Creative Commons Attribution 4.0 International Licence: <https://creativecommons.org/licenses/by/4.0/>.

3. PROJECT AND FUNDING INFORMATION

Title: Novel design analysis tools to increase precision and reduce variation in hip replacement performance

Dates: 1st June 2016 to 31st May 2022

Funding organisation: Engineering and Physical Sciences Research Council

Grant no.: EP/N02480X/1

This work was funded by the EPSRC through grant EP/N02480X/1 and supported by the National Institute for Health Research (NIHR) Leeds Biomedical Research Centre (BRC).

Raw data used in this study was collected under the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement no. GA-310477 LifeLongJoints.

4. CONTENTS

The data types listed below start with the highest-level summary of the study data and progress through several layers of detail, finishing with the raw outputs from the study codes. The final entry in the list is the input data to the study.

Summary statistics for acetabular cup orientation angles – group level

This data represented a high-level summary of the acetabular cup angles (inclination and version) through the gait cycle. The extremes of cup orientation are captured here, along with the range of movement throughout the walking gait cycle.

SummaryFastSlowGroups.csv

1 file, CSV datasheet

The data includes the max angle, min angle, min range, and max range, across each group (fast and slow walking speeds).

The data is also given for five “implantation angles”. Please see methods document for details.

Summary statistics for acetabular cup orientation angles – patient level

This data include maximum, minimum and range data for the inclination and version angle through the gait cycle for each patient.

AnalysedResults.zip

1 ZIP file, containing 5 CSV datasheets

The data is divided into separate sheets by assumed implantation angle.

AnalysedResults_30_05.csv

AnalysedResults_30_25.csv

AnalysedResults_45_07.csv

AnalysedResults_50_05.csv

AnalysedResults_50_25.csv

Each file contains results for one “implantation angle” given in the file name. Within the file the data is organised by slow and fast walking groups.

Patients are listed under the local sequential codes. Please see patient code document for details.

The meaning of each measure is listed at the bottom of each datasheet.

Acetabular cup orientation angles – patient level

These data sheets include the full set of inclination and version angles through the gait cycle for each patient. There is one set of data per patient generated by taking an average over the trials for that that person.

TrialMean_InclinationVersion_Data.zip

1 ZIP file, containing 20 CSV datasheets

TrialMean_Fast_Inclination_XX_YY.csv

TrialMean_Fast_Version_XX_YY.csv

TrialMean_Slow_Inclination_XX_YY.csv

TrialMean_Slow_Version_XX_YY.csv

The data is divided into separate sheets by patient group, orientation angle measured, and implantation angle assumed.

In the file names here, XX is the implantation inclination and YY is the implantation version.

Within the datasheets:

Patients are listed under the local sequential codes.

Please see patient code document for details.

MeanTrial_InclinVersion_Plot_45_07.pdf

1 PDF document

A plot comparing the two patient groups in terms of mean and range of the orientation angles, for one implantation position.

Acetabular cup orientation angles – trial level

The datasheets include the raw inclination and version angles through the gait cycle, for all individual trials and all patients. That raw data is also plotted on interactive HTML plots. These are given for each patient combined with each implantation position. There are also plots showing all angle data through the gait cycle, coloured by patient group.

RawTrials_InclinationVersion_Data.zip

1 ZIP file, containing 5 CSV datasheets

RawTrials_InclinationVersion_30_05.csv
RawTrials_InclinationVersion_30_25.csv
RawTrials_InclinationVersion_45_07.csv
RawTrials_InclinationVersion_50_05.csv
RawTrials_InclinationVersion_50_25.csv

The data is divided into separate sheets by assumed implantation angle.

The data is separated into a sheet for each implantation position.
All 39 patients listed by LLJ patient code.
Please see patient code document for details.

Cup inclination data is included for all walking trials separately, at all 101 points through the gait cycle.

RawTrials_InclinationVersion_HTMLplots.zip

1 ZIP file, containing 195 HTML files

ZZZangles_XX_YY.html

An interactive HTML plot of the inclination angle plotted against the version angle throughout the gait cycle, is given for each patient (n=39) and for each implantation orientations (n=5).

In the file names here, XX is the implantation inclination, YY is the implantation version and ZZZ is the patient code. Each inclination-version plot includes a curve for each trial.

RawTrials_InclinVersion_FastBluevsSlowGreen.html

1 file, HTML format

The same inclination-version plot described above, with all trials for all patients overlaid. The fast and slow groups are labelled in different colours to illustrate differences.

RawTrials_Inclination_FastBlackvsSlowRed.html
RawTrials_Version_FastBlackvsSlowRed.html

2 files, HTML format

Two separate plots, one for the inclination angle and one for the version angle, plotted against gait cycle point.

All trials for all patients are overlaid and the fast and slow groups are labelled in different colours to illustrate differences.

Acetabular cup orientation vectors – trial level

The inclination and version angles given above have been derived from the outward facing normal vector of the plane aligned with the acetabular cup rim. (Please see method document for details.) These datasheets tabulate that raw vector data.

RawTrials_CupNormal_Data.zip

1 ZIP file, containing 5 CSV
datasheets

The data is separated into a sheet for each assumed
implantation position.

All 39 patients listed by LLJ patient code. Please see
patient code

RawTrials_CupNormal_30_05.csv

RawTrials_CupNormal_30_25.csv

RawTrials_CupNormal_45_07.csv

RawTrials_CupNormal_50_05.csv

RawTrials_CupNormal_50_25.csv

The data is separated into a sheet for each assumed
implantation position.

All 39 patients listed by LLJ patient code. Please see
patient code document for details.

Three trials are included per patient. The datasheet
contains zeros in the small number of cases where a trial
was unsuccessful.

The X, Y, Z components of the cup normal vector are given
for all 101 points through the gait cycle. (Please see
methods document for coordinate system details.)

[Study input data] Pelvic angles through the gait cycle

This datasheet contains the input data for this study, specifically the three angles defining the pelvic orientation through the gait cycle, for all subjects and all trials.

PelvicAnglesGait_AllSubjectTrials.csv

1 file, CSV datasheet

All 39 patients listed by LLJ patient code. Please see
patient code document for details.

Three trials are included per patient. The datasheet
contains zeros in the small number of cases where a
trial was unsuccessful.

The angles listed are tilt, obliquity and internal-external
rotation. Please see methods document.

5. METHODS

Patient details and codes

Patients_Codes_Trials.csv The two sets of codes for the 39 patients included in the study are listed for cross referencing. The “Patient code” is taken from the LifeLongJoints project and the “Sequential code” is specific to each sub-group in this study and the latter is only for use in the processed data presented here. A sex is listed for each patient, along with the hip side (left/right) which was studied. The number of successful trials is also stated for each patient.

Method documentation

Method_LLJ_PelvicMotion.pdf Includes: 1) details of the gait data collection in the Life Long Joints project, 2) the selection of the sub-groups of patients used for this study, and 3) the derivation of the pelvic angles through the gait cycle.

Method_DynamicOrientation.pdf Includes: 1) definition of the implantation position, 2) computational steps for vector calculation, 3) definition of the inclination and version angles, and 4) the basic data processing steps.

Statistical analysis

Statistical_Analysis.pdf Statistical comparisons between the fast and slow walking groups for average behaviour over the gait cycle and behaviour throughout the cycle.
Sensitivity to the cup implantation position.
Correlation analysis between the pelvic angles and the cup orientation angles.