

Materials Design Analysis Reporting (MDAR) Checklist for Authors

The [MDAR framework](#) establishes a minimum set of requirements in transparent reporting mainly applicable to studies in the life sciences.

eLife asks authors to **provide detailed information within their article** to facilitate the interpretation and replication of their work. Authors can also upload supporting materials to comply with relevant reporting guidelines for health-related research (see [EQUATOR Network](#)), life science research (see the [BioSharing Information Resource](#)), or animal research (see the [ARRIVE Guidelines](#) and the [STRANGE Framework](#); for details, see *eLife*'s [Journal Policies](#)). Where applicable, authors should refer to any relevant reporting standards materials in this form.

For all that apply, please note **where in the article** the information is provided. Please note that we also collect information about data availability and ethics in the submission form.

Materials:

Newly created materials	Indicate where provided: section/figure legend	N/A
The manuscript includes a dedicated "materials availability statement" providing transparent disclosure about availability of newly created materials including details on how materials can be accessed and describing any restrictions on access.		This study did not generate newly created biological materials requiring a dedicated materials availability statement.

Antibodies	Indicate where provided: section/figure legend	N/A
For commercial reagents, provide supplier name, catalogue number and RRID , if available.		No antibodies were used as study reagents.

DNA and RNA sequences	Indicate where provided: section/figure legend	N/A
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Short novel DNA or RNA including primers, probes: Sequences should be included or deposited in a public repository.		No novel DNA or RNA sequences, primers, or probes are reported in this study
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Cell materials	Indicate where provided: section/figure legend	N/A
Cell lines: Provide species information, strain. Provide accession number in repository OR supplier name, catalog number, clone number, OR RRID.		No cell lines were used.
Primary cultures: Provide species, strain, sex of origin, genetic modification status.		No primary cell cultures were used.

Experimental animals	Indicate where provided: section/figure legend	N/A
Laboratory animals or Model organisms: Provide species, strain, sex, age, genetic modification status. Provide accession number in repository OR supplier name, catalog number, clone number, OR RRID.	Mouse embryos were used. Mouse strains and reporter lines are listed in the Key Resources Table	
Animal observed in or captured from the field: Provide species, sex, and age where possible.	Animal details are described in the Materials and Methods	

Plants and microbes	Indicate where provided: section/figure legend	N/A
Plants: provide species and strain, ecotype and cultivar where relevant, unique accession number if available, and source (including location for collected wild specimens).		No plants were used.
Microbes: provide species and strain, unique accession number if available, and source.		No microbes were used.

Human research participants	Indicate where provided: section/figure legend) or state if these demographics were not collected	N/A
If collected and within the bounds of privacy constraints report on age, sex, gender and ethnicity for all study participants.		This study did not involve human participants.

Design:

Study protocol	Indicate where provided: section/figure legend	N/A
If the study protocol has been pre-registered, provide DOI. For clinical trials, provide the trial registration number OR cite DOI.		The study was not pre-registered and is not a clinical trial.

Laboratory protocol	Indicate where provided: section/figure legend	N/A
Provide DOI OR other citation details if detailed step-by-step protocols are available.		Detailed step-by-step procedures are provided in the Materials and Methods, including mouse strains, embryo culture, live imaging, cell tracking, and microinjection

		procedures.
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Experimental study design (statistics details) *		
For in vivo studies: State whether and how the following have been done	Indicate where provided: section/figure legend. If it could have been done, but was not, write "not done"	N/A
Sample size determination	Not done. No formal sample-size calculation was performed; sample sizes were determined by the availability of suitable embryos and datasets for the imaging and validation analyses.	
Randomisation	Not done. Samples were not randomized because this was an observational developmental imaging study.	
Blinding	Not done. Blinding was not performed, as the analyses relied on image-based registration and computational quantification of embryo datasets.	
Inclusion/exclusion criteria	Inclusion and exclusion criteria are described in the Results and Materials and Methods. Embryos were excluded when a substantial portion of the IFT was lost due to embryo drift, and stage 1 was excluded from cumulative deformation analyses because substantial myocardial differentiation occurs between stages 1 and 2.	

Sample definition and in-laboratory replication	Indicate where provided: section/figure legend	N/A
State number of times the experiment was replicated in the laboratory.	The analyses were performed on multiple independent embryos, including 16 embryos in the overall dataset, 11 embryos for stepwise deformation analysis, 9 embryos for cell-tracking validation, and 6 embryos for in vivo boundary validation experiments.	
Define whether data describe technical or biological replicates.	The data represent biological replicates at the embryo level.	

	Computational analyses were repeated across independent embryos and time-lapse datasets.	
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Ethics	Indicate where provided: section/submission form	N/A
Studies involving human participants: State details of authority granting ethics approval (IRB or equivalent committee(s), provide reference number for approval.		This study did not involve human participants.
Studies involving experimental animals: State details of authority granting ethics approval (IRB or equivalent committee(s), provide reference number for approval.	All mouse experiments were approved by the CNIC and Universidad Autónoma de Madrid Committees for "Ética y Bienestar Animal" and the Area of "Protección Animal" of the Community of Madrid, reference PROEX 220/15.	
Studies involving specimen and field samples: State if relevant permits obtained, provide details of authority approving study; if none were required, explain why.		No specimen or field samples were used.

Dual Use Research of Concern (DURC)	Indicate where provided: section/submission form	N/A
If study is subject to dual use research of concern regulations, state the authority granting approval and reference number for the regulatory approval.		This study is not subject to dual use research of concern regulations.

Analysis:

Attrition	Indicate where provided: section/figure legend	N/A
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Describe whether exclusion criteria were pre-established. Report if sample or data points were omitted from analysis. If yes, report if this was due to attrition or intentional exclusion and provide justification.	Exclusion criteria were pre-established for the deformation analysis. A subset of embryos was excluded because a substantial portion of the IFT was lost due to embryo drift, and stage 1 was excluded from cumulative analysis because myocardial differentiation contributes substantially between stages 1 and 2.	
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Statistics	Indicate where provided: section/figure legend	N/A
Describe statistical tests used and justify choice of tests.	Statistical analyses are described in the Materials and Methods and figure legends. The study reports mean values, variability measures, and comparisons across developmental stages and embryos; the analysis includes validation against manually tracked cell positions and cross-embryo mapping onto the Atlas.	

Data availability	Indicate where provided: section/submission form	N/A
For newly created and reused datasets, the manuscript includes a data availability statement that provides details for access (or notes restrictions on access).	The raw data, source data, and supplementary data have been deposited in Mendeley Data (DOI: 10.17632/nd3kmj3cnx.2).	
When newly created datasets are publicly available, provide accession number in repository OR DOI and licensing details where available.		
If reused data is publicly available provide accession number in repository OR DOI, OR URL, OR citation.	Raiola, Morena; Torres, Miguel (2026), "A method for analysing tissue motion and deformation during mammalian cardiogenesis. Raiola et al.2025b", Mendeley Data, V2, doi: 10.17632/54gbvnsgnp.2	

Code availability	Indicate where provided: section/figure legend	N/A

For any computer code/software/mathematical algorithms essential for replicating the main findings of the study, whether newly generated or re-used, the manuscript includes a data availability statement that provides details for access or notes restrictions.	The computational workflow relies on previously described and cited paper: Raiola, Morena; Torres, Miguel (2025), "A method for analysing tissue motion and deformation during mammalian cardiogenesis." The software, libraries, and computational tools used in this study are cited in the Materials and Methods and listed in the Key Resources Table.	
Where newly generated code is publicly available, provide accession number in repository, OR DOI OR URL and licensing details where available. State any restrictions on code availability or accessibility.	<i>In-silico</i> fate map is available in https://github.com/MorRaiola/BarelHeartModel.git	
If reused code is publicly available provide accession number in repository OR DOI OR URL, OR citation.	Raiola, Morena; Torres, Miguel (2025), "A method for analysing tissue motion and deformation during mammalian cardiogenesis.": Code is available in github.com/MorRaiola/QuantitativeAnalysisOfHTMorphogenesis.git .	

Reporting:

The MDAR framework recommends adoption of discipline-specific guidelines, established and endorsed through community initiatives.

Adherence to community standards	Indicate where provided: section/figure legend	N/A
State if relevant guidelines (e.g., ICMJE, MIBBI, ARRIVE, STRANGE) have been followed, and whether a checklist (e.g., CONSORT, PRISMA, ARRIVE) is provided with the manuscript.	The study follows relevant transparent reporting expectations for animal and life science research, including the MDAR framework and animal ethics requirements.	

* We provide the following guidance regarding transparent reporting and statistics; we also refer authors to [Ten common statistical mistakes to watch out for when writing or reviewing a manuscript](#).

Sample-size estimation

- You should state whether an appropriate sample size was computed when the study was being designed
- You should state the statistical method of sample size computation and any required assumptions
- If no explicit power analysis was used, you should describe how you decided what sample (replicate) size (number) to use

Replicates

- You should report how often each experiment was performed
- You should include a definition of biological versus technical replication
- The data obtained should be provided and sufficient information should be provided to indicate the

- number of independent biological and/or technical replicates
- If you encountered any outliers, you should describe how these were handled
- Criteria for exclusion/inclusion of data should be clearly stated
- High-throughput sequence data should be uploaded before submission, with a private link for reviewers provided (these are available from both GEO and ArrayExpress)

Statistical reporting

- Statistical analysis methods should be described and justified
- Raw data should be presented in figures whenever informative to do so (typically when N per group is less than 10)
- For each experiment, you should identify the statistical tests used, exact values of N, definitions of center, methods of multiple test correction, and dispersion and precision measures (e.g., mean, median, SD, SEM, confidence intervals; and, for the major substantive results, a measure of effect size (e.g., Pearson's r, Cohen's d)
- Report exact p-values wherever possible alongside the summary statistics and 95% confidence intervals. These should be reported for all key questions and not only when the p-value is less than 0.05.

Group allocation

- Indicate how samples were allocated into experimental groups (in the case of clinical studies, please specify allocation to treatment method); if randomization was used, please also state if restricted randomization was applied
- Indicate if masking was used during group allocation, data collection and/or data analysis