

Nima Ashjaee

PhD Candidate, Biomedical Engineering, The University of British Columbia
Vancouver, BC, Canada | nima@ashjaee.com | nima.ashjaee@ubc.ca | ashjaee.com
[Google Scholar](https://scholar.google.com/citations?user=U8vYUgIAAAAJ) | github.com/NimaAsh | [linkedin.com/in/nashjaee](https://www.linkedin.com/in/nashjaee)

RESEARCH PROFILE

Biomedical engineer working between medical imaging, computational modeling, and spine surgery. My doctoral research converts routine clinical imaging (biplanar radiographs and CT) into subject-specific musculoskeletal models of adults with spinal deformity and relates the predicted junctional loads to surgical outcome. I now use deep learning and vision foundation models to automate this image-to-model pathway. Nine peer-reviewed journal articles (four first-author in 2025–2026), one granted US patent, and 17 conference presentations.

EDUCATION

- PhD, Biomedical Engineering, The University of British Columbia** 2020 – Dec 2026 (expected)
Thesis: Subject-Specific Musculoskeletal Modeling in Adult Spinal Deformity
Supervisors: Dr. Thomas R. Oxland and Dr. Sidney Fels. Committee: Dr. John Street, Dr. Purang Abolmaesumi. Advanced to candidacy October 2023.
- MSc, Mechanical Engineering, University of Saskatchewan** 2015 – 2018
Thesis: Comparison of a novel surgical implant with the volar locking plate for the treatment of distal radius fractures: a mechanical study
Supervisor: Dr. James D. Johnston. GPA 91%.
- BSc, Mechanical Engineering, Ferdowsi University of Mashhad, Iran** 2011 – 2015
GPA 18.45/20 (3.95/4.0, WES). Ranked first of approximately 100 students.

TECHNICAL EXPERTISE

Medical imaging	CT and biplanar (AP and lateral) radiographs; digitally reconstructed radiographs (DRRs) generated from CT; bone segmentation from CT (thresholding, seed-based region growing) and surface reconstruction (NURBS); vertebral landmark annotation and multi-rater reliability; DICOM handling and radiograph calibration; quantitative CT (QCT) density mapping to finite element models.
3D morphology and alignment	3D spine reconstruction from biplanar landmarks with spline fitting; spinopelvic and sagittal parameters (PI, PT, SS, LL, TK, SVA, TPA, GAP score); vertebral geometry; landmark perturbation and error-propagation analysis.
Computational modeling	Subject-specific musculoskeletal modeling (ArtiSynth, OpenSim, OpenSim Moco, SCONE); static optimization; hybrid finite element and rigid-body models; finite element analysis (ABAQUS with Fortran user subroutines; QCT-FE, XFEM, strain-energy bone remodeling); CAD (SolidWorks, Geomagic); cadaveric biomechanical testing.
AI and machine learning	PyTorch, scikit-learn; CNN landmark detection (ResNet/FPN, DSNT heatmaps, cross-view fusion); vision foundation models (DINOv2, RAD-DINO) and self-supervised pretraining (masked autoencoders); random forests, autoencoders, and MLPs; multi-GPU training on SLURM H100 clusters.
Programming	Python (NumPy, SciPy, pandas, PyTorch), MATLAB, Java, C, Fortran, Julia, TypeScript/Next.js, FastAPI, Git, LaTeX.
Statistics and clinical research	Logistic models with leave-one-out and nested cross-validation, AUROC, permutation testing, intraclass correlation. Human-participant research under UBC Clinical (H22-00865) and Behavioural (H23-00961) Research Ethics Board approvals.

RESEARCH EXPERIENCE

Doctoral Researcher

May 2020 – present

Orthopaedic and Injury Biomechanics Group, ICORD, and School of Biomedical Engineering, UBC, Vancouver

- Built an image-to-model pipeline that turns pre- and postoperative biplanar radiographs into subject-specific thoracolumbar musculoskeletal models (ArtiSynth), and applied it to 48 adult spinal deformity surgical patients (96 models).
- Identified a two-term junctional load profile (postoperative compression and perioperative change in anteroposterior shear) that discriminated revision-requiring proximal junctional failure better than eight clinical and radiographic comparators (manuscript in preparation).
- Quantified how vertebral landmark error propagates into spinal loads, using CT-derived DRRs of ten deformity patients, a four-phase perturbation design, and a six-rater study (four researchers, two spine surgeons) run on a web annotation platform I built. Compression agreement held to 6.7 mm of landmark error, shear to only 2.2 mm.
- Developed machine learning models (Python) that infer 575 muscle force capacities and 4,008 muscle path coordinates from demographics and vertebral geometry across 250 CT-based spine models, reducing shear-force error from 238 N to 178 N relative to anthropometric scaling. Code released open source.
- Tested whether the outcome signal survived inferred muscle properties, 1–3 mm landmark perturbations, and alternative upper instrumented vertebra levels, as a first step toward comparing surgical plans.
- Led a 12-author perspective paper with spine surgeons and biomechanists from UCSF, Harvard Medical School, ETH Zurich, UC San Diego, and the University of Guelph (JOR Spine, 2025).

Research Engineer

2019 – 2021

ICORD, University of British Columbia, Vancouver

- Developed 3D multibody dynamics simulations using CAD modeling and Java programming.

Graduate Researcher (MSc)

2015 – 2018

Department of Mechanical Engineering, University of Saskatchewan, Saskatoon

- Segmented clinical CT of the distal radius (half-maximum-height thresholding with seed-based region growing), reconstructed NURBS bone geometry, and built subject-specific QCT-FE models in which voxel-level elastic moduli were mapped to integration points through ABAQUS user subroutines (Fortran).
- Coupled these models with strain-energy-based adaptive bone remodeling to compare long-term density changes around a novel intramedullary fracture implant (US Patent 12,082,847) and the volar locking plate.
- Iterated the implant design with CT-derived 3D-printed bone models and cadaveric trials, optimized porous sphere geometry with finite element analysis and regression, and built a passive wrist-joint simulator to test fracture stability under cyclic loading in seven cadaveric forearms.
- Compared constant-E, node-based, and element-based QCT-FE material mapping against 16 indentation measures in four proximal tibiae. Element-based mapping converged with 2.5 mm elements (versus 1.5 mm) with similar accuracy (4.9% prediction error), shortening run time.

APPLIED AI AND SOFTWARE PROJECTS

Biplanar radiograph vertebral landmark detection

2026

- PyTorch pipeline that predicts T1–L5 vertebral centroids from paired AP and lateral radiographs: weight-shared ResNet-34 encoder with cross-view FiLM fusion, FPN decoder, DSNT heatmap head, and per-vertebra visibility, with public (AASCE) and clinical datasets unified into one label space.
- Mean radial error of 6.6 px at 384 px input (PCK@0.05 of about 0.95) on a held-out biplanar test set. Integrated vision foundation-model backbones (DINOv2, RAD-DINO), adapted the model to a retrospective surgical cohort, and served it through a FastAPI inference server.

Contributor, MedARC open-science medical AI

2026 – present

- Co-author of nanopath, an open framework and benchmark for training and evaluating pathology foundation models on a single H100 GPU.
- Implemented streaming data loading and 8×H100 distributed pretraining for a 3D brain MRI foundation model (FOMO26 challenge).

Zyra, spine deformity planning research platform

2025 – present

- TypeScript/Next.js workstation for biplanar radiograph import and calibration, vertebral landmarking with sagittal spline fitting, spinopelvic alignment parameters, comparison of construct scenarios, and load estimation through a headless ArtiSynth service.

INDUSTRY EXPERIENCE

R&D Engineer, Progressive Automations, Richmond, BC

Aug 2021 – Mar 2022

- Designed electric linear actuators and oversaw their manufacture with overseas suppliers.

Mechanical Engineer, SED Systems, Saskatoon, SK

2018 – 2019

- Analyzed composite samples with high-resolution quantitative CT imaging and destructive testing (MATLAB) to optimize the manufacturing process.

Mechanical Engineer, Sterilecare, Saskatoon, SK

2017 – 2018

- Designed and analyzed an alternative vial for lock-solution delivery using finite element analysis (ABAQUS) and CAD (SolidWorks).

PUBLICATIONS

Peer-reviewed journal articles

1. **Ashjaee N**, Fels S, Street J, Oxland TR. Sensitivity of spinal load estimates to vertebral landmark error in biplanar radiograph-based musculoskeletal models. *Computer Methods in Biomechanics and Biomedical Engineering*. 2026. Published online 4 Sep 2026. doi:10.1080/10255842.2026.2727107
2. **Ashjaee N**, Street J, Fels S, Oxland TR. Machine learning outperforms anthropometric scaling in predicting muscle parameters and spinal loading: a subject-specific musculoskeletal modeling study. *European Spine Journal*. 2026. Published online 12 Apr 2026. doi:10.1007/s00586-026-09878-1
3. **Ashjaee N**, Semonche A, Mikula AL, Kiss L, Anderson DE, Ignasiak D, Brown SHM, Street J, Fels S, Ward SR, Ames C, Oxland TR. Subject-specific musculoskeletal modeling: the future of predicting and preventing proximal junctional failure in adult spinal deformity. *JOR Spine*. 2025;8(4):e70142. doi:10.1002/jsp2.70142
4. **Ashjaee N**, Fels S, Street J, Oxland TR. Effects of using generic vs. subject-specific muscle properties on spinal load prediction across different posture simulations. *Journal of Biomechanics*. 2025;188:112741. doi:10.1016/j.jbiomech.2025.112741
5. Jafari B, Katoozian HR, Tahani M, **Ashjaee N**. A comparative study of bone remodeling around hydroxyapatite-coated and novel radial functionally graded dental implants using finite element simulation. *Medical Engineering & Physics*. 2022;102:103775.
6. **Ashjaee N**, Hosseini Kalajahi SM, Johnston JD. QCT-FE modeling of the proximal tibia: effect of mapping strategy on convergence time and model accuracy. *Medical Engineering & Physics*. 2021;88:41–46.
7. Pai S A, Zhang H, **Ashjaee N**, Street J, Wilson D, Brown SHM, Fels S, Oxland TR. Estimation and assessment of sagittal spinal curvature and thoracic muscle morphometry in different postures. *Proceedings of the Institution of Mechanical Engineers, Part H*. 2021;235(8):883–896.
8. Di Y, Wasan EK, Cawthray J, Syeda J, Ali M, Cooper DML, Al-Dissi A, **Ashjaee N**, Cheng W, Johnston J, Weekes DM, Kostelnik TI, Orvig C, Wasan KM. Evaluation of La(XT), a novel lanthanide compound, in an OVX rat model of osteoporosis. *Bone Reports*. 2021;14:100753.
9. Hosseinitabatabaei S, **Ashjaee N**, Tahani M. Introduction of maximum stress parameter for the evaluation of stress shielding around orthopedic screws in the presence of bone remodeling process. *Journal of Medical and Biological Engineering*. 2017;37(5):703–716.

Manuscripts in preparation or under review

1. **Ashjaee N**, Fels S, Street J, Oxland TR. Subject-specific musculoskeletal modelling suggests a muscle-dependent mechanical load profile of proximal junctional failure in adult spinal deformity. Manuscript in preparation, 2026.
2. Scotti PS, Muhammad H, Kim R, **Ashjaee N**, Grandhi RS, Rahbar S, Bijou R, Dulal A, Feng C, Lane C, Warner B, Abraham TM. Nanopath: fast, fair, open experimentation for pathology foundation models. Under review, NeurIPS 2026 Workshop (ASCI), 2026.

Patent

1. Johnston GHF, **Ashjaee N**, Johnston JD. Implant for bone fracture stabilization. US Patent 12,082,847 B2. Granted 10 September 2024 (filed 15 August 2019).

Conference presentations

1. **Ashjaee N**, Street J, Fels S, Oxland TR. Beyond anthropometric scaling: improving spinal load prediction via machine learning-derived muscle parameters. 10th World Congress of Biomechanics (WCB 2026), Vancouver, Canada, July 2026. Poster P2-169.
2. **Ashjaee N**, Fels S, Street J, Oxland TR. Enhancing proximal junctional failure prediction through subject-specific musculoskeletal modeling. 19th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE 2024), Spine Meets Clinic Symposium, Vancouver, Canada, July 2024. Podium.
3. **Ashjaee N**, Fels S, Street J, Oxland TR. Analysis of the lumbar spine L4–L5 disc with a hybrid finite element and rigid body musculoskeletal model. CMBBE 2024, Vancouver, Canada, July 2024. Podium.
4. **Ashjaee N**, Fels S, Street J, Oxland T. Refining gender-based musculoskeletal models: the impact of age adjustment. 50th Annual Meeting of the International Society for the Study of the Lumbar Spine (ISSLS), Milan, Italy, May 2024. Podium (MP-10b).
5. **Ashjaee N**, Fels S, Street J, Oxland T. Impact of generic vs. subject-specific muscle parameters on spinal load prediction in musculoskeletal modeling. ISSLS 50th Annual Meeting, Milan, Italy, May 2024. Special Poster (SP-2f).
6. Barrett JM, Malakoutian M, Fels SS, Brown SHM, Oxland TR, **Ashjaee N**. Can muscle short-range stiffness stabilize the spine? ISSLS 50th Annual Meeting, Milan, Italy, May 2024. Poster.
7. Barrett J, Brown SHM, Oxland TR, **Ashjaee N**. The structure of spine biomechanics research. ISSLS 50th Annual Meeting, Milan, Italy, May 2024. Poster.
8. **Ashjaee N**, Johnston G, Johnston JD. A mechanical comparison of a novel surgical implant with the volar locking plate to stabilize distal radial fractures. 2nd International Combined Meeting of Orthopaedic Research Societies (ICORS), Montréal, Canada, June 2019. Podium; abstract in *Orthopaedic Proceedings*, 2020.
9. **Ashjaee N**, Johnston G, Johnston JD. Evaluation of long-term effects of a novel surgical implant and the volar locking plate using adaptive finite element modelling. ICORS, Montréal, Canada, June 2019. Podium; abstract in *Orthopaedic Proceedings*, 2020.
10. **Ashjaee N**, Johnston G, Johnston JD. Specifications and design optimization of a novel surgical implant to stabilize distal radial fractures. ICORS, Montréal, Canada, June 2019. Poster.
11. Di Y, Wasan EK, Cawthray J, Syeda J, Ali M, Cooper D, Al-Dissi A, **Ashjaee N**, Cheng W, Johnston J, Kostelnik T, Orvig C, Wasan KM. Evaluation of a novel lanthanide compound (La(XT)) in an OVX rat model of osteoporosis. Canadian Society for Pharmaceutical Sciences Annual Symposium, Vancouver, Canada, May 2019. Poster.
12. **Ashjaee N**, Johnston JD. Investigation of an improved element-based approach for simulating bone remodeling. 20th Biennial Meeting of the Canadian Society for Biomechanics, Halifax, Canada, August 2018. Podium.
13. **Ashjaee N**, Hosseini Kalajahi M, Johnston JD. Accounting for Young's modulus variability "inside" elements for subject-specific FE modeling. 18th Annual Alberta Biomedical Engineering Conference, Banff, Canada, November 2017. Poster.
14. **Ashjaee N**, Johnston G, Johnston JD. Assessment of novel surgical implant using mechanical testing and extended finite element method (XFEM). University of Saskatchewan Life and Health Sciences Research Expo, Saskatoon, Canada, May 2017. Poster.
15. McDonald M, Johnston JD, Kawalilak C, **Ashjaee N**, Bunyamin A, Johnston G, Kontulainen SA. A new pQCT strength index predicts up to 90% of variance in bone failure load at the distal radius. 17th Annual Alberta Biomedical Engineering Conference, Banff, Canada, October 2016. Podium.
16. **Ashjaee N**, Kontulainen SA, Johnston G, Johnston JD. Bench-testing a novel surgical implant to stabilize distal radial fractures. 16th Annual Alberta Biomedical Engineering Conference, Banff, Canada, November 2015. Poster.
17. **Ashjaee N**, Hosseinitabatabaei S, Tahani M. Design optimization of an orthopedic screw based on stress stimulus using Taguchi method and finite element analysis. 2nd National Conference on Applied Research in Electrical, Mechanical, and Mechatronics Engineering, Tehran, Iran, 2015.

TEACHING

Guest Lecturer, BMEG 330, The University of British Columbia Finite element and multibody dynamics modeling: elements, shape functions, boundary conditions, CT-based material mapping, and bone–implant adaptation. Delivered in three offerings of the course.	2023 – present
Graduate Teaching Assistant, The University of British Columbia APSC 172 (2025W, 2026W), MECH 221 (2025W), MECH 325 (2025W), BMEG 357 (2025W Term 2)	2025 – present
Sessional Lecturer, University of Saskatchewan Dynamics II. Full responsibility for course materials, lectures, and examinations.	2019

LEADERSHIP AND SERVICE

Co-chair, Symposium “Spine Meets Clinic” (Sessions I–III) 19th CMBBE Symposium, Vancouver. Co-organized with T. Oxland, S. Fels, and J. Barrett; speakers included C. Ames, D. Ignasiak, S. Ward, S. Brown, and J. Street. The symposium led to the JOR Spine perspective paper.	July 2024
Industry Liaison, Biomedical Engineering Graduate Association (BMEGA), UBC	May 2022 – Apr 2023
Program Coordinator, UBC Vancouver Summer Program Academic program for international undergraduate students.	Apr – Aug 2022
Graduate Academic Assistant, School of Biomedical Engineering, UBC 2021–2022 program accreditation project.	Feb – Aug 2022

HONOURS AND AWARDS

President’s Academic Excellence Initiative PhD Award, UBC	2020, 2021, 2022, 2026
Faculty of Applied Science Graduate Award, UBC	2020
International Tuition Award, UBC	2020
Saskatchewan Innovation and Opportunity Scholarship, University of Saskatchewan	2016
Graduate Research Fellowship, University of Saskatchewan	2015
Outstanding Undergraduate Student, Ferdowsi University of Mashhad	2015
Qualified for membership, Iran’s National Elites Foundation	2015
Distinguished Researcher of the Year, Department of Mechanical Engineering, Ferdowsi	2014
Exempted from the national MSc entrance exam as an exceptionally talented student	2014
Top 0.25% of more than 280,000 participants, national university entrance exam, Iran	2011

PROFESSIONAL DEVELOPMENT

Technology Entrepreneurship (APSC 541), UBC	2024
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