

# Identifying Anterior Cruciate Ligament Injuries through Automated Video Analysis of In-Game Motion Patterns

## Authors

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## Affiliations

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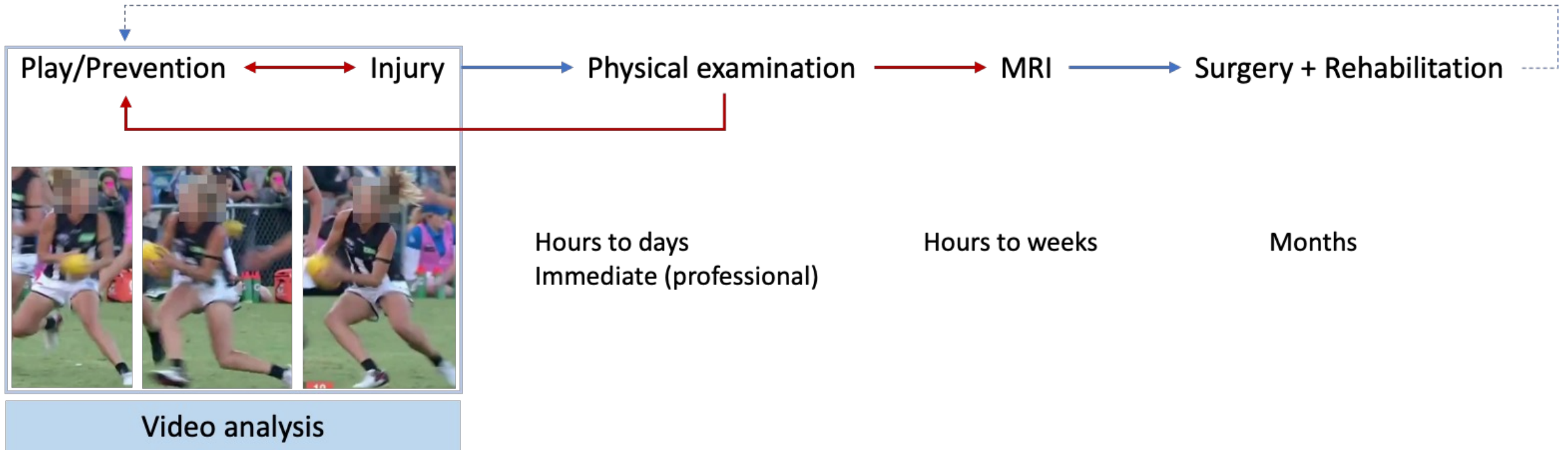
## Conflict of interest

Zoltán Toser is the CEO of Argus Cognitive, Inc. (Lebanon, NH, United States) with an ownership stake.

Attila Schulc is a paid employee of Argus Cognitive Hungary Kft. (Subsidiary of Argus Cognitive, Inc. in Budapest, Hungary)

Mate Csakvari is a paid employee of Argus Cognitive Hungary Kft. (Subsidiary of Argus Cognitive, Inc. in Budapest, Hungary)

# Introduction



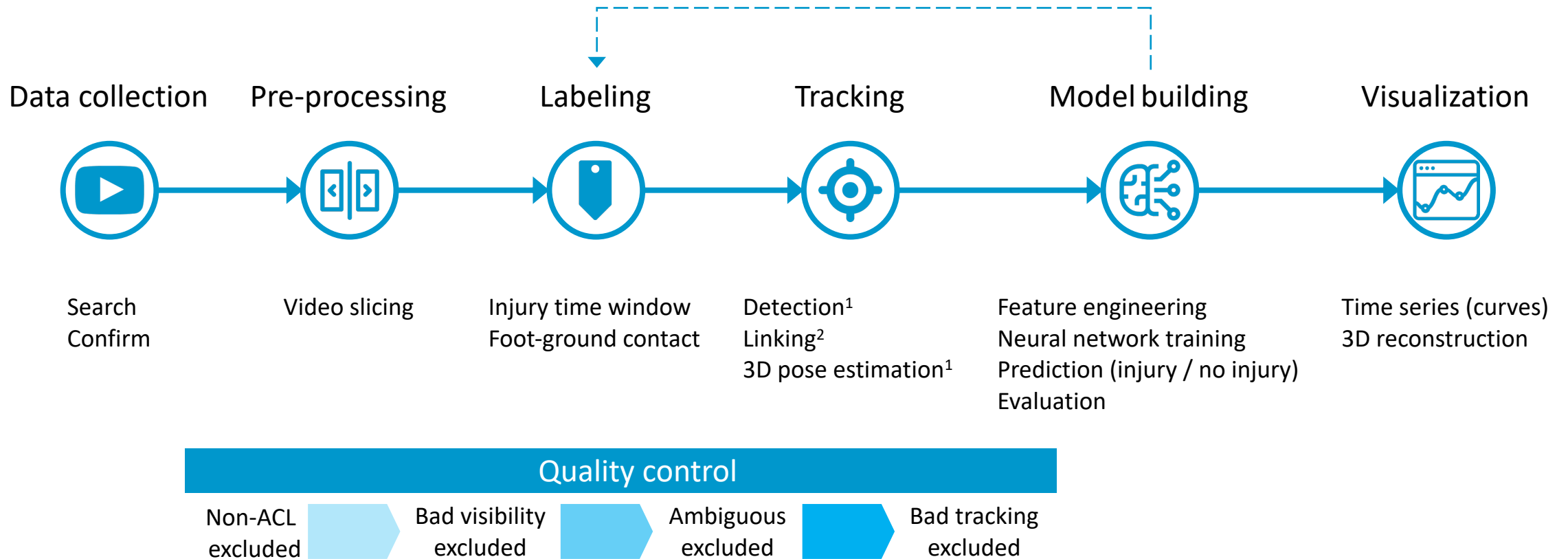
## Long-term objectives

- Identify trends and changes in athletes motion
- Prevention

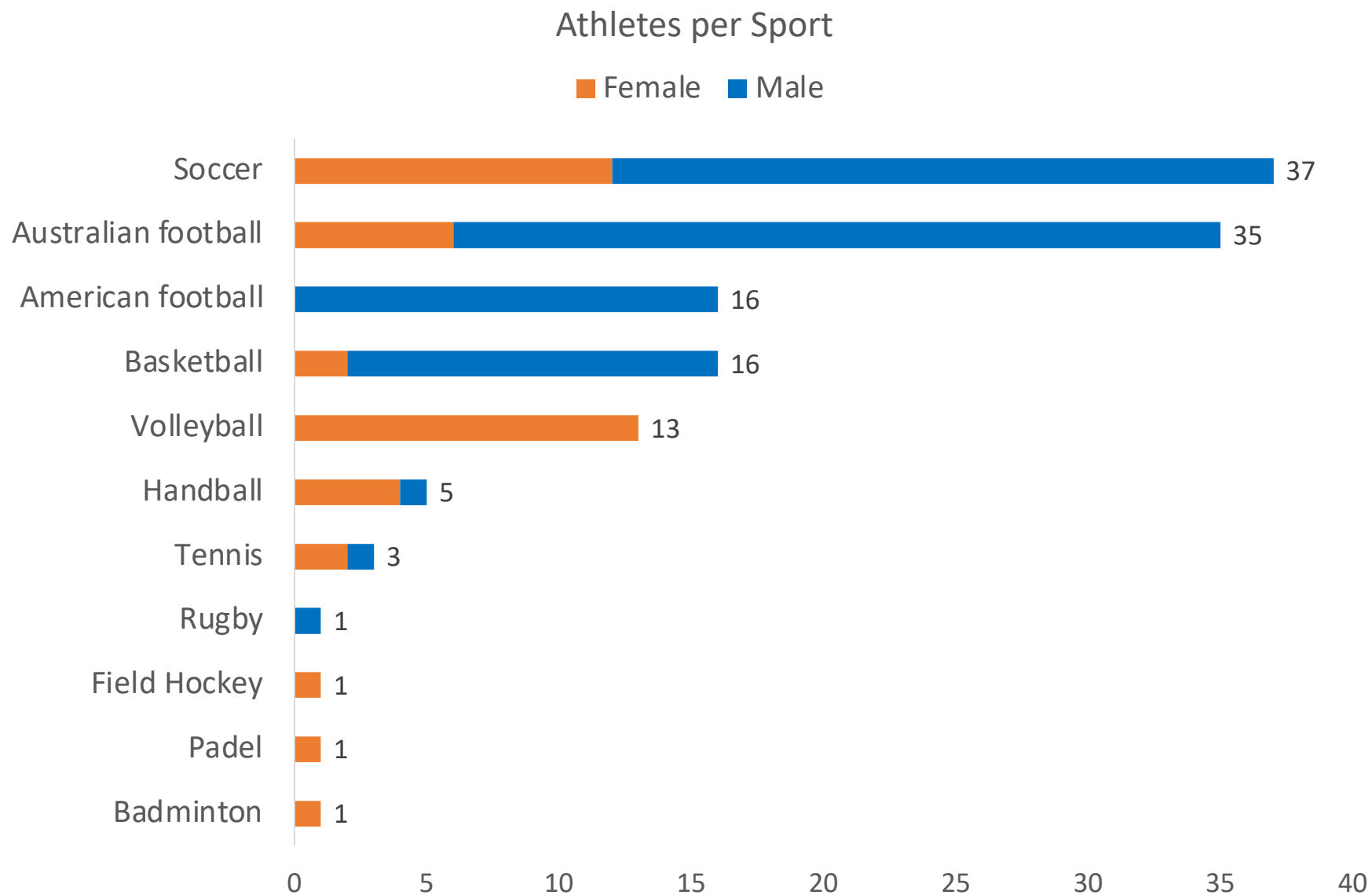
## Short-term objectives

- Identify biomechanical patterns associated with ACL injuries;
- Present data as information for doctors;
- Evaluate the efficacy of using this data for early diagnosis;
- Automatic injury recognition.

# Data workflow



# Video dataset



## Annotated dataset

**11** sports

**210** video segments

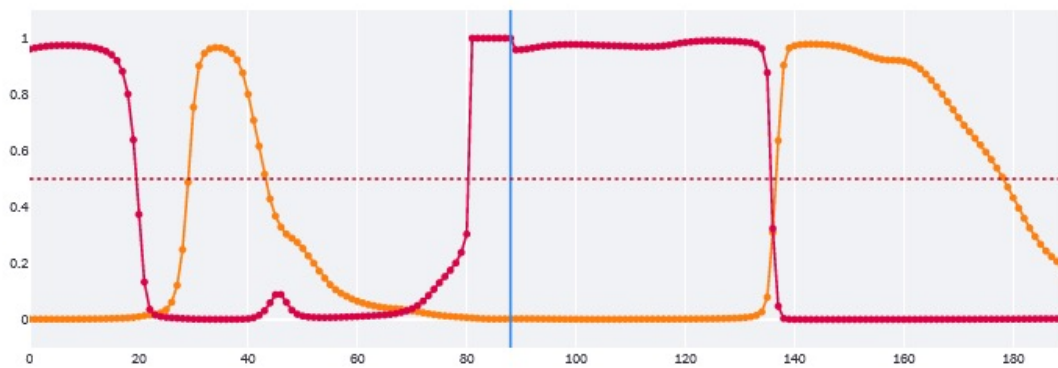
**5.3 ± 3.5 sec** duration

**129** athletes in total

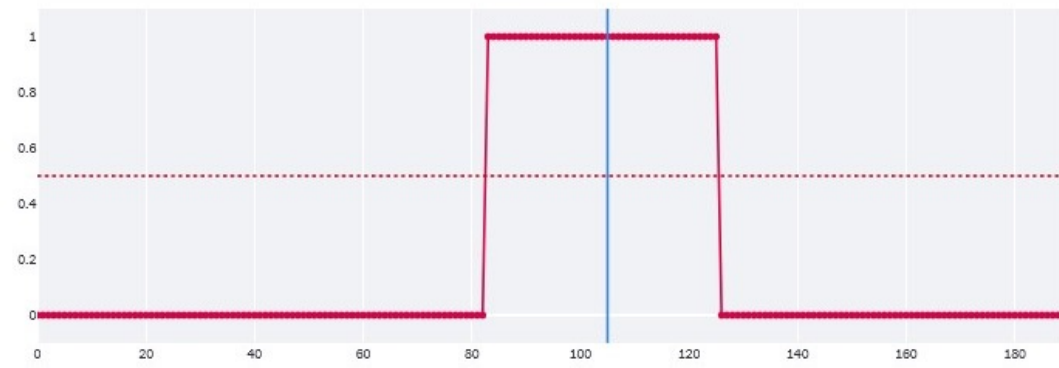
**91** injury **31** control

**1:2** female to male ratio

# Annotation tool

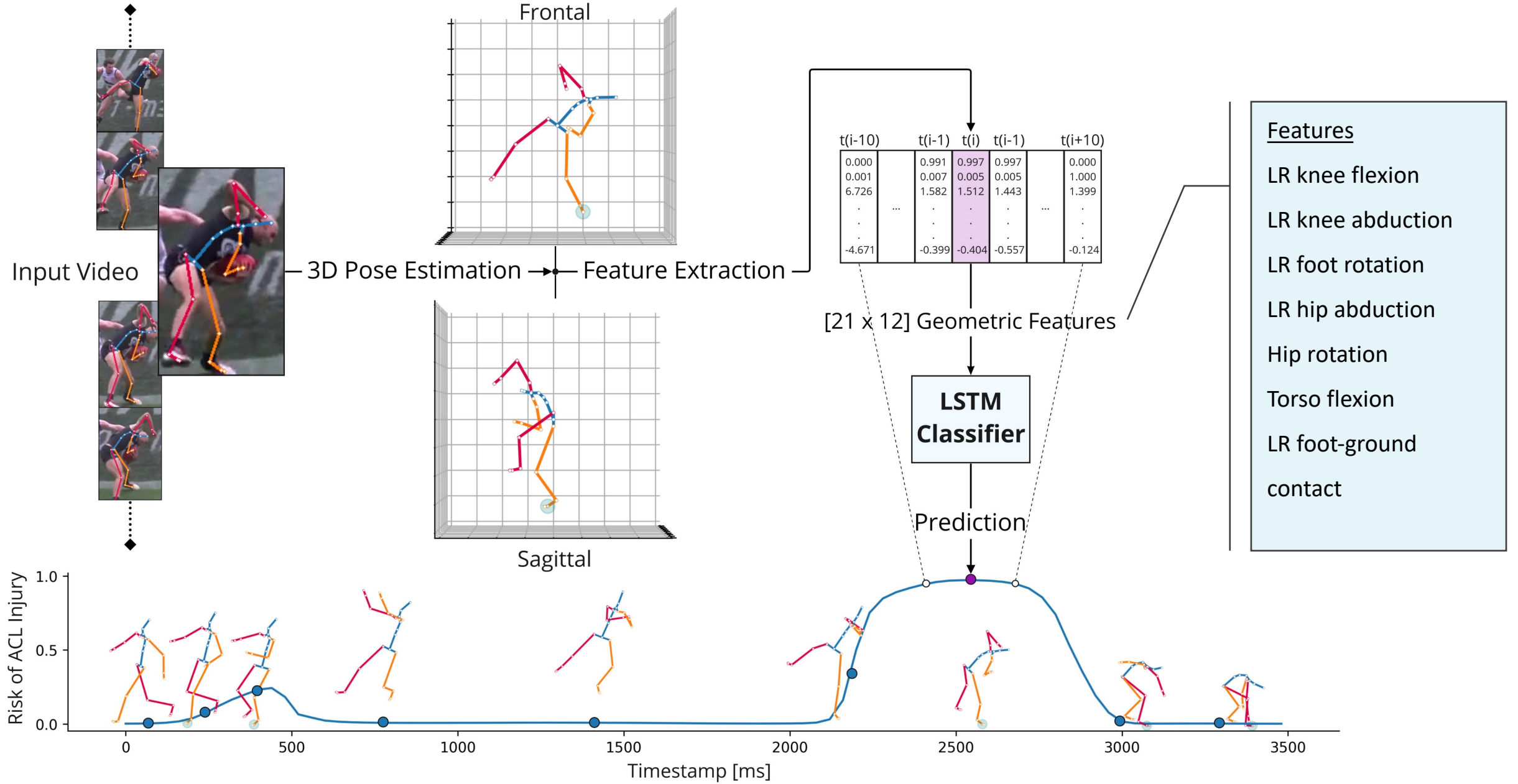


-Right Ground Contact- -Left Ground Contact-



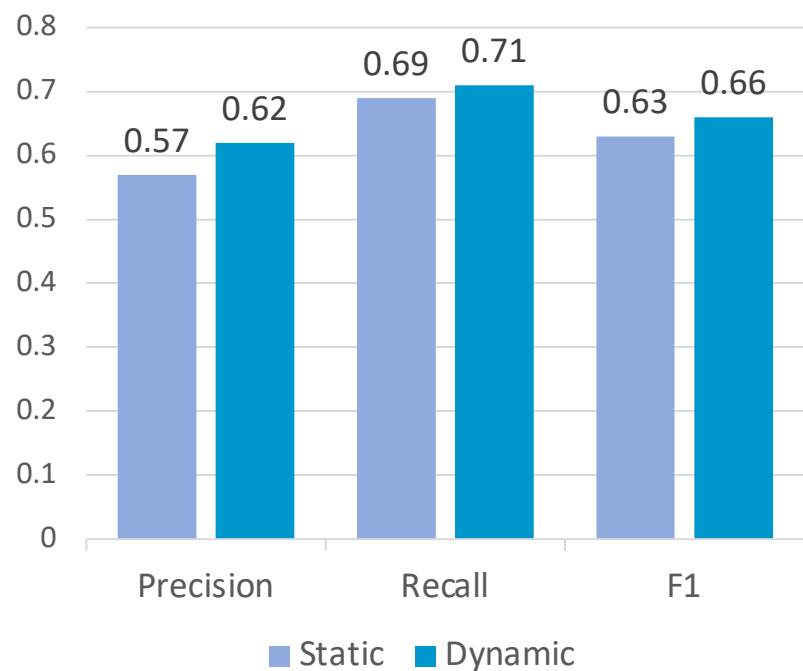
-ACL Injury-

# Model building

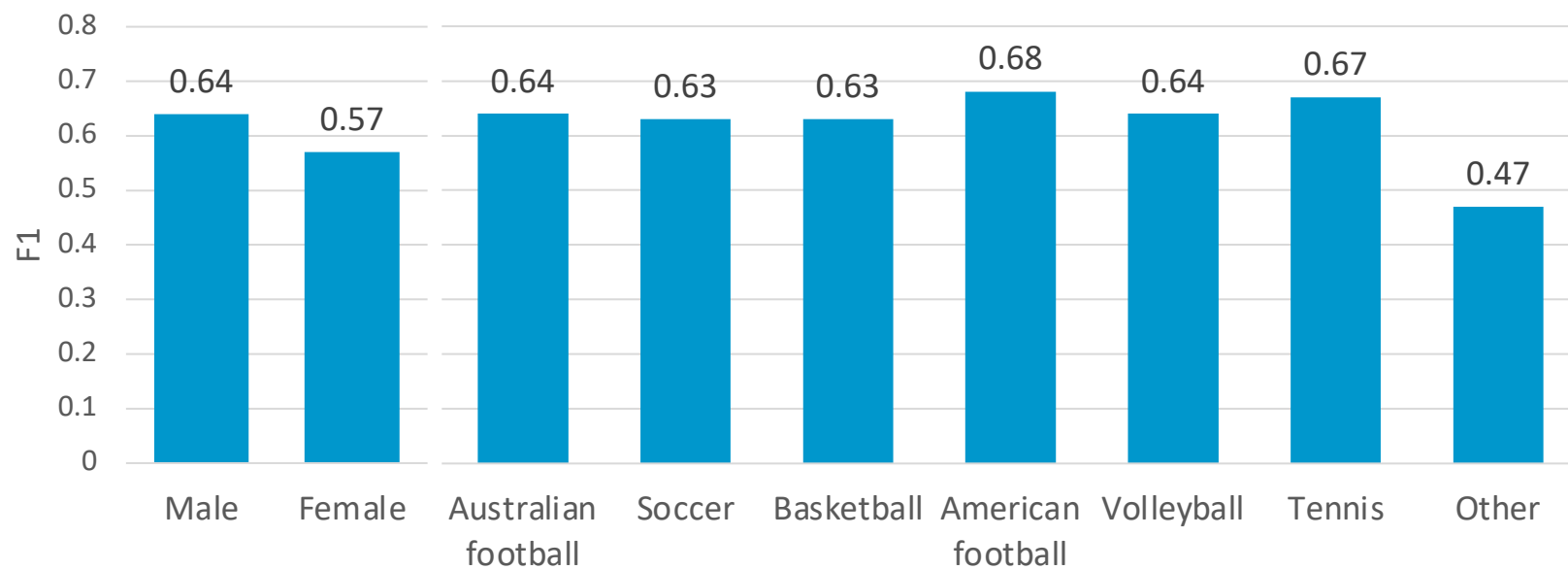


# Model performance

## Overall

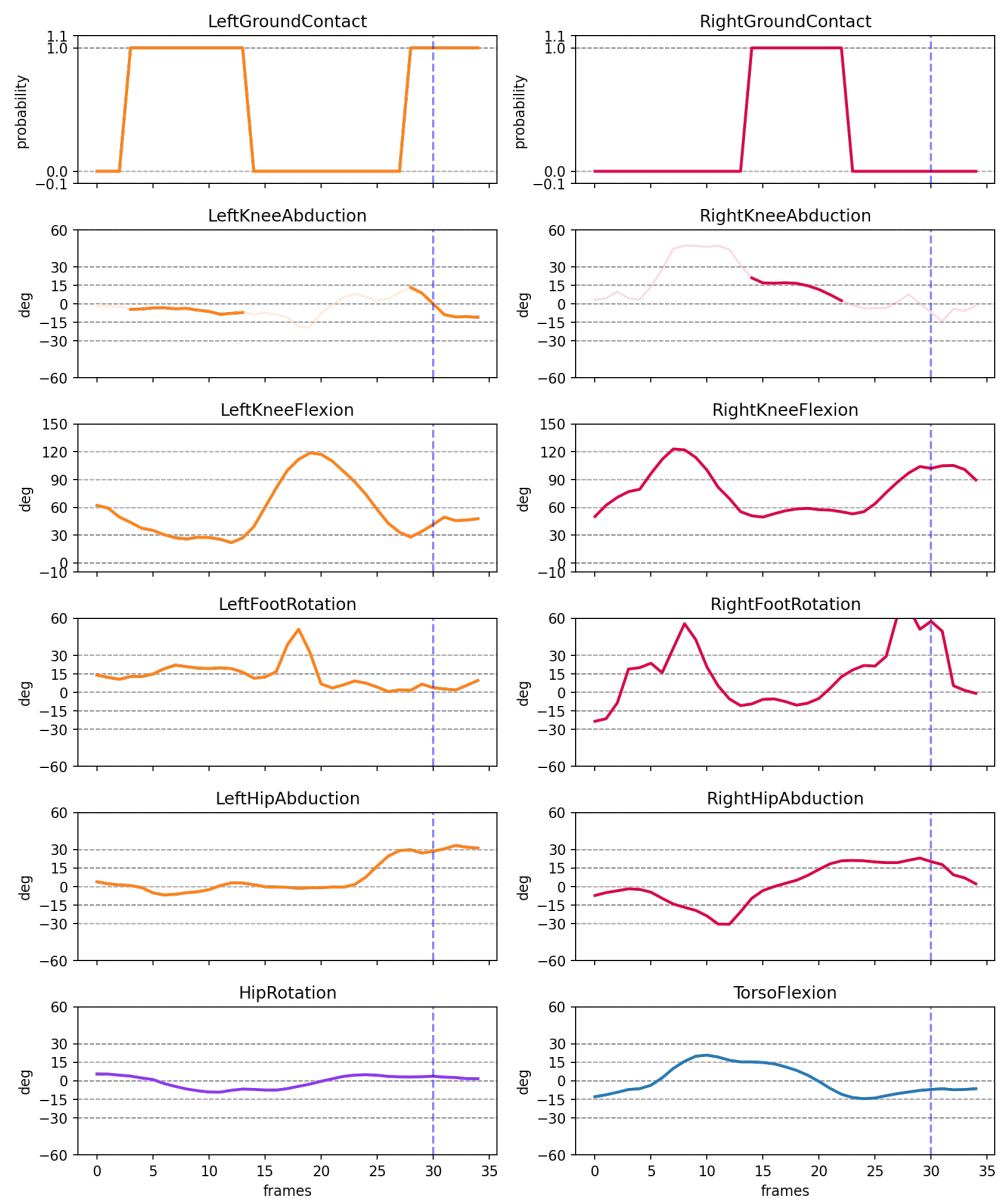


## Differences within subgroups

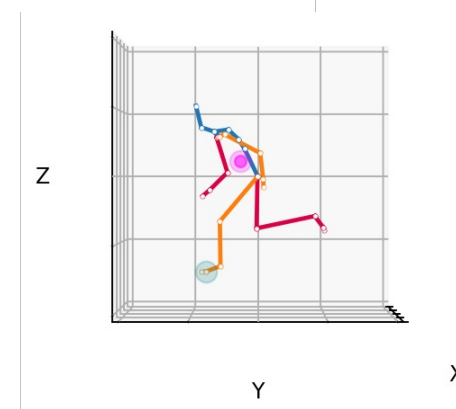
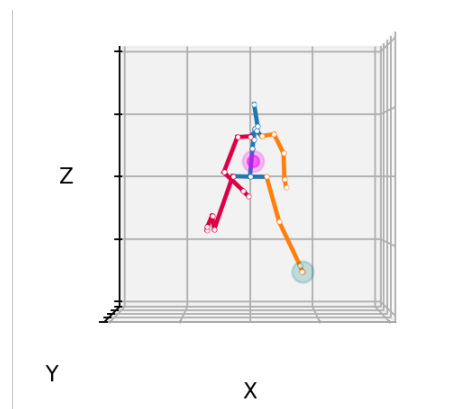
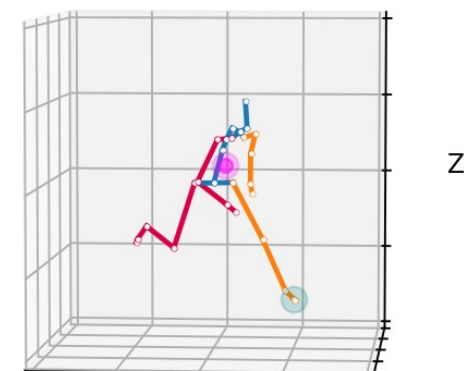




# Experiment with experts



Scenario	Precision	Recall	F1	TN	FP	FN	TP
Expert A	0.615	0.364	0.457	22	5	14	8
Expert A + Visualization	0.611	0.500	<b>0.550</b>	20	7	11	11
Expert B	0.680	0.708	0.694	17	8	7	17
Expert B + Visualization	0.895	0.708	<b>0.791</b>	23	2	7	17



# Conclusions

- ACL injury dataset built from in-game video footage.
- Deep learning algorithms are successful in reconstructing 3D poses from single camera view.
- Geometrical features are effective in modeling ACL injuries.
- Automated analysis of biomechanical pathological patterns associated with ACL injuries.
- Pilot study with orthopaedic surgeons shows improved diagnostic ability when watching real game situations.
  
- Long-term goal: injury prevention via early detection of at-risk motion patterns.

## Contacts

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## References

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2. Zhang Y, Sun P, Jiang Y, et al. Bytetrack: Multi-object tracking by associating every detection box. *European Conference on Computer Vision*. 2022:1-21.