

## **Review of Doctoral Thesis**

<b>1. PhD candidate</b>
Ing. David Rebenda / david.rebenda@vut.cz
<b>2. Name of PhD programme</b>
Design and Process Engineering (Mechanical Engineering Design)
<b>3. Title of PhD thesis</b>
Effect of Viscosupplementation on Friction of Articular Cartilage

<b>4. Principal supervisor</b>
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<b>5. Co-supervisor</b>
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<b>6. Reviewer</b>
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<b>7. Overview of the scope of PhD thesis<sup>1</sup></b>
<b>Very good</b>
The thesis reviews the state of the art in viscosupplementation which to date has been mainly a rheological characterization. In this work the candidate combines rheological analysis with tribological measures of cartilage against glass, PVA hydrogel against glass, and several commercial viscosupplements. The study design is good and the results are presented in a generally clear and appropriate manner. While effects of composition, concentration, Mw, speed, load, etc showed some effect, most were quite small and so it is worth asking if viscosupplements act through a mechano-tribological mechanism or another mode. Particularly, the candidate should think about the potential biochemical effects or immune modulation properties of these viscosupplements.

<b>8. Significance of the topic and clarity of problem statement</b>
<b>Very good</b>
Viscosupplementation is a strongly debated topic in the orthopaedics community and is of great importance to the field. As the thesis states, there are conflicting guidance from professional medical societies regarding its use. In general, viscosupplementation is a safe practice, minimally invasive, and may offer benefit if even through placebo effect. It would be good for the candidate to discuss the duration

<sup>1</sup> Overview of the scope of PhD thesis is a short description of objectives of PhD thesis's research and summary of main findings and scientific achievements.

of repair from viscosupplementation and how this compares to phosphate buffered saline injections which have shown improvements out to 6 months and platelet rich plasma. One suggestion for the thesis is to make the link clearer that the candidate is aiming to link rheological performance with tribological. While this should work in the context of fluid film lubrication it should have little dependence on other modes and this appears to be the finding in this work. I would like to hear more discussion around what the findings tell us about the lubrication modes of cartilage.

#### **9. Knowledge of existing literature**

##### **Good**

The candidate has demonstrated a good knowledge of the literature throughout the thesis. This is demonstrated by a good range of citations and references of prior art. However, the thesis does not provide a deep understanding of the multitude of lubrication theories proposed for cartilage, rather it gives an overview. It would be good for the candidate to identify the lubrication modes that the results directly support or refute and give some detailed analysis. As a matter of personal interest, I would like to hear the candidate discuss their thoughts on how tribological rehydration may have played a role.

#### **10. Choice of methods and technical soundness**

##### **Good**

The data are presented well and information can be generally understood by just looking at the figures and captions. The candidate did well at maintaining consistent methods across multiple studies. I am unsure how the candidate selected certain testing conditions as no references or analysis was provided. For example, the sliding speeds used, the duration of sliding, the point at which friction was measured. If these values were based on some version of a scaled day, contact stress, etc it would be good to know. Several figures would have benefited from some supplemental plots that show the temporal data. Bar charts are great for summarizing the data but these temporal studies can be so rich with information.

#### **11. Quality, originality and significance of the results**

##### **Good**


The candidate has performed high quality work with originality and is important to the field of orthopaedics, tribology, and rheology. Specifically, the combination of tribology and rheology for viscosupplements is certainly an understudied problem and this work helps to address some of the current questions. While the results don't demonstrate wildly unexpected results the studies are well formulated and ask appropriate questions. It was mentioned several times in the thesis that repeatability was an issue with biological specimens however only average responses were shown without error bars or individual data points. Knowledge of this scatter would help in understanding the potential clinical significance of the results.

#### **12. Quality of attached papers**

##### **Good**

The attached papers are good examples of published work that provide both important technical information, methods, and results.

#### **13. Overall assessment, strengths and weaknesses (based upon the above evaluation categories 8–12)**

<b>Evaluate:</b>	
Overall, the candidate has done very good work that merits the title of PhD. The main strengths of this work are clear and consistent methods, simple but good studies, and clear presentation of the findings. The main weaknesses are the lack of an in-depth analysis on what this means to the actual lubrication of cartilage (which lubrication theories are correct/wrong/most likely), what this means for wear (only friction and rheology were discussed), what this means in terms of the clinical outcomes and how we can improve viscosupplementation or alternative methods.	
<b>14. Questions and comments</b>	
None at this time.	
<b>15. Conclusion</b>	
PhD thesis is an independent scientific work that presents a novel solution to a significant problem in the research area and demonstrates the candidate's ability to conduct independent research.	
<b>YES</b>	
<b>16. Date and signature</b>	
<b>26/07/2021</b>	

Please note

- A. Evaluate categories 7 to 13 using the following scale: unacceptable, acceptable, satisfactory, good, very good, excellent. The qualification of 'excellent' should only be given for a PhD Thesis in the top 3% of the research in your field of expertise.
- B. E-mail the completed form to: [Klara.Javorcekova@vut.cz](mailto:Klara.Javorcekova@vut.cz)