Comparison of Post Traumatic Osteoarthritis Injury Initiation Methods in an Ovine Model

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| Alan Getgood       | **Speaker:** Conmed  
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Post-traumatic osteoarthritis (PTOA) is a significant complication of sports trauma.

It is postulated that this occurs in response to joint impact and this may be exacerbated with a concomitant ACL or meniscal injury.

Previous ACL transection[1] and femoral condyle impact[2] models have been validated in ovine models; however, there is limited information available regarding the effectiveness of combined impact and meniscal injury model.

There is a significant need for a clinically translatable animal model to further investigate the pathogenesis of PTOA, as well as investigate the development of disease modifying molecules.
Purpose and Hypothesis

To develop and validate an ovine model that can mimic the impaction injury seen at the time of anterior cruciate ligament injury to investigate the development and propagation of PTOA.

It was hypothesized that a combined meniscal injury with impaction will result in greater progression of osteoarthritis compared to an impact only in an ovine model.
Animals and Surgical Protocol

- Twelve skeletally mature sheep
- All protocols approved by Western’s Animal Use Committee
- A medial parapatellar arthrotomy exposed the medial femoral condyle (MFC) and the medial meniscus of each hind limb
Animals and Surgical Protocol

• The animals were randomized to either:
  
  i) **impact only** – 30MPa impact to the proximal, middle, and distal aspect of the MFC
  
  ii) **impact + meniscus** – in addition to the impact, an anterior medial meniscus destabilising root transection was performed

• The contralateral limb received an arthrotomy only

• The animals were sent to pasture for 3 months at which time they were euthanized and the joints analysed
Methods

Assessment

• Micro-CT scanning
  - Subchondral bone analysis
  - Custom regions of interest through the weight bearing sections of the MFC and MTP

• Macroscopic assessment
  - Modified ICRS

• Ink staining for surface assessment\[^2\]
  - Calculate % surface area with cartilage degeneration

• Histology\[^3\]
  - Histological sections from MFC and MTP
  - H&E and Safranin-O
Results

Macroscopic assessment and surface area

- Both models produced significantly greater macroscopic scores compared to the arthrotomy controls; the impact + meniscus model was more severe compared to the impact only.
- Both models had significantly greater damage to the articular surface compared to the arthrotomy controls; there was no significant difference between injury models.
Results

Imaging

- Across all imaging parameters there was a significant difference between the injury and controls with respect to trabecular number.
Results

Histology

- There were no statistical differences in histology scores between the injury models and the arthrotomy controls with respect to the MFC.

- On the MTP, there was a significant interaction such that there was a significant difference between the treatments and controls for the impact + meniscus injury model.

- There were also significant differences between the two injury models for both the injury and control conditions.
Discussion and Conclusions

• Both models were successful at initiating PTOA but the impact with a concomitant meniscal injury produced more severe PTOA.

• The impact with meniscal injury model also produced greater damage throughout the joint and did not appear to be limited to the articular surface.

• An injury to the soft tissue may disturb the native joint kinematics while also initiating different biological pathways compared to damage that only occurs to the joint surface.

• The imaging and histology results also suggest that specimens may have been in the early stages of OA and greater damage may have been realized with more time between injury initiation and sacrifice.
References

