Biomechanical Factors Associated with Knee Pain in Cyclists: A Systematic Review of the Literature

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Biomechanical Factors Associated with Knee Pain in Cyclists: A Systematic Review of the Literature

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Purpose

- This systematic review will focus on literature related to positioning on, and configuration of the bicycle that can influence forces acting on the knee and their potential effects on injury. This review also aims to present recommendations for rehabilitation and injury prevention based on the findings in current literature. The goal of this research was to develop an algorithm that can be used in guiding decision making for the sports medicine practitioners.

Clinical Relevance

- Roughly thirty-three million United States residents ride a bicycle an average of 6 days/month for an average of >1 hour/day
- Knee pain is the most common overuse injury in cycling
- Elite professional 38% traumatic injuries and 62% overuse injuries
- Anterior knee pain is the most common complaint among cyclists seeking medical care, and accounts for 25% of overuse injuries in cycling.
- The iliotibial band (ITB) is the most common cause of lateral knee pain in cyclists.
  - Hills can cause repetitive forceful shearing at the knee
  - Saddle too high or too far forward
  - Medial knee pain can also be experienced by cyclists
  - Patellar tendinitis
  - Patellar ligament
  - Medial meniscus tear is least common reason
  - The high demand of pressure during the downstroke is the proposed mechanism for the development of PFPS or “kicker’s knee”
  - More common in females
  - High Q angle predisposes individual to condition
  - Increased saddle position has a negative effect on knee biomechanics

Methods

- Review Protocol
  - Based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines
- Search Terms
  - knee injuries, knee pain, cycling, cyclist, and overuse.
- Data Extraction
  - Knee pain, cycling parameters, number of subjects, gender, EMG activity, bike-fit, and limitations
- Grading the Evidence
  - Downs and Black Questionnaire was used
  - Consolation between all 4 researchers and faculty advisor to resolve discrepancies
  - Risk of bias include lack of randomization and lack of level 1 evidence.

Results

- Different between cyclists with and without knee pain
- Cyclists with prior history of injury may adapt a more medial knee position which reduces stress on the patellofemoral joint and provides a larger base of support.
- Greater discomfort observed in cyclists with history of injury during phase of pedal cycle when knee flexion is found to be
  - Effects of different saddle and foot position
  - Saddle
    - Backward saddle positions increase bicipital anterior shear force
    - Compensatory forces are more sensitive to knee flexion angles
    - Compensatory forces relate to increased patellofemoral knee pain
    - Low saddle height may contribute to anterior knee pain
- Knee flexion angle appears to be sensitive to changes in saddle height, low saddle height produces significantly higher knee flexion angle
- High saddle height relates to lateral knee pain (ITBS) due to increased time within the knee impingement state
- Foot position
  - Increased inversion may reduce patellofemoral pain syndrome
  - Due to changes in muscles activation and potential reduction in lateral patellar tracking
  - Increased pronation leads to increased tibial rotation and increased values forces at the knee
  - Peak varus force decreases with 10 degrees of extension of the foot
  - A more neutral foot and knee position is beneficial for reducing overuse knee injuries
- No ideal foot position noted in the literature to prevent most knee injuries
- Alternations in foot position may alleviate pain in cyclists with knee pain

Limitations

- Limited experimental studies comparing cyclists with and without knee pain
- Studies containing data on cyclists with knee pain but limited research regarding preventative measures in those without knee pain
- Few randomized control trials across the literature on the topic
- Low to moderate evidence per Downe and Black grading scales
- Little research regarding effects of positioning in cyclists with posterior or medial knee pain

Conclusions

- "Optimal" bike fit inconsistent across the literature
- No single configuration shown to decrease or prevent knee pain
- Inconclusive data regarding biomechanical differences in cyclists with and without knee pain
- Recommendation for further experimental research in manipulating various bicycle components to determine an optimal configuration to prevent or alleviate knee pain in cyclists

References