ACL consensus on treatment, outcome, and return to sport

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Beginning in 1986, the University of Pittsburgh Department of Orthopaedic Surgery has hosted the Panther Symposium as a consortium of international sports medicine experts, with a particular focus on the management of anterior cruciate ligament (ACL) injury. While the Panther Symposium is now well into its fourth decade of existence, each meeting has sought broad perspective to foster communication and collaboration, encourage scientific exploration, build consensus, and, ultimately, improve patient care. It was in this rich tradition that an international, multidisciplinary group of ACL clinical and research experts collaborated in a consensus-building effort that culminated in the ACL Consensus Meeting Panther Symposium 2019 held on June 5–7, 2019, at the University of Pittsburgh Medical Center in Pittsburgh, Pennsylvania, USA. The symposium was organized around three areas of ACL injury controversy, including (1) treatment, (2) clinical outcomes, and (3) return to sport (RTS). The three resulting consensus papers are found in this issue of *Knee Surgery, Sports Traumatology, and Arthroscopy* [1–3].

The consensus-building effort began 1 year prior to the 2019 ACL Consensus Meeting and utilized a process based on the modified Delphi method. Sixty-six international experts on the management of ACL injuries, representing 18 countries and 6 continents, were assigned to one or more consensus groups on the aforementioned three themes. Proposed consensus statements organized across the three themes were drafted by the Scientific Organizing Committee and Session Chairs. Consensus group members completed an Internet-based survey to indicate agreement or disagreement and to provide feedback on the statements. After 2 days

of evidence-based presentations by symposium members attending the ACL Consensus Meeting, the second round of the modified Delphi process was held as a structured session where each statement generated from the Internet-based survey was discussed and revised, after which a final vote was then held. Eighty percent agreement was defined a-priori to constitute consensus. Statements that did not reach 80% agreement were reported as such. Two liaisons assigned to each theme documented the discussion, revised each statement at the requests of the consensus group, and completed a literature review of MEDLINE to be included in support (or contradiction) of the finalized statements. A summary of the finalized statements, comprising the themes of treatment, clinical outcomes, and RTS, are as follows:

Treatment after anterior cruciate ligament injury In terms of operative vs. non-operative treatment after ACL injuries, 11 of 12 statements met 80% agreement. Consensus was reached that both operative and non-operative treatment options may be acceptable, depending on patient characteristics, including the type of sporting demands, anatomical differences (e.g., tibial slope, femoral morphology, and mechanical alignment), and the presence of concomitant injuries (e.g., meniscus, cartilage, and other ligaments). The physician and patient should engage in a shared decision-making process that considers the patient's presentation, goals, and expectations, informed by a balanced presentation of the available evidence-based literature, when considering operative versus non-operative treatment. After ACL injury, a period of progressive rehabilitation to improve impairments and overall function may be offered regardless of whether operative or conservative management is subsequently pursued. In active patients engaged in jumping, cutting, and pivoting sports (e.g., soccer, football, handball, and basketball), early anatomic ACL reconstruction is recommended to maintain athletic participation in the medium-to-long term (1 to 5+ years after injury) and to reduce the high risk of secondary meniscus and cartilage injuries associated with non-operative treatment or delayed surgery. For patients who wish to return to straight plane activities (e.g., running, swimming, and weight-lifting), non-operative treatment with

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structured, progressive rehabilitation is an acceptable treatment option. However, patients presenting with instability during their desired activity despite optimal rehabilitation should be referred for operative treatment. The development of osteoarthritis following ACL injury is multifactorial and the evidence is presently inconclusive following operative or non-operative treatment. There was disagreement preventing consensus on whether delayed operative treatment should be considered an option for a temporary return to athletic participation to complete a competitive season/event, even if the patient accepts the risk of additional injury.

Clinical outcomes after anterior cruciate ligament injury

Of the original 13 statements on clinical outcomes following ACL injury, 9 reached consensus after incorporation of 4 statements that were excluded due to similarity in content. The primary outcome of interest is improvement from pre-treatment status, for which minimum description should include demographic data, validated knee-specific patient-reported outcome (PRO) assessment, health-related quality of life (HRQoL), and measures of type and level of pre-injury sport/activity. Comprehensive assessment after ACL surgery at a minimum follow-up of 2 years should include objective measures of anteroposterior and rotatory knee laxity, clinical measures of knee function and structure, PROs, activity level, and recurrent ligament disruption. Medium-to-long-term follow-up (5+ years) should additionally include measures of post-traumatic osteoarthritis. The minimal length of follow-up depends on the outcome being assessed and should optimally include 80% of the entire cohort, with the necessary sample size determined by a-priori power calculation. Assessment of PRO should optimally include at least one knee-specific outcome tool, one activity rating scale, and one measure of HRQoL. The recommended knee-specific outcome measure for ACL injury and treatment is the IKDC Subjective Knee Form. Measurement of the patient acceptable symptom state (PASS) is also valuable in facilitating interpretation of PRO.

Return to sport after anterior cruciate ligament injury

All 11 statements regarding return to sport (RTS) after ACL injury reached consensus. RTS after ACL injury is ultimately characterized by the achievement of the pre-injury level of sport and should be conceptualized as a continuum from return to participation, which includes unrestricted training followed by full participation, to return to sport and ultimately return to performance. Sports medical clearance is to be made prior to progressing the patient to unrestricted training and competition, and clearance to full participation (i.e., practice followed by competition) should be a multidisciplinary decision involving the patient, parent (if minor), surgeon, team physician, and physical therapist/athletic trainer. RTS should follow a structured plan to return to practice before progressive return to competition. Purely time-based RTS decision-making should be abandoned.

Rather, RTS decision-making should include objective physical examination data and validated, peer-reviewed RTS testing that involves functional assessment and psychological readiness, with consideration for biological tissue healing, contextual factors, and concomitant injuries.

The strong consensus of statements among the international, multidisciplinary group of experts attending the 2019 ACL Consensus Meeting Panther Symposium should assist clinicians in managing the ACL-injured patient. Nevertheless, there are still many questions that warrant future investigation. There remains a need for larger randomized trials in which early surgery (followed by rehabilitation) is compared with a strategy of early rehabilitation and/or delayed surgery. There are also insufficient data to guide treatment in instances when there are concomitant meniscal, chondral, and/or collateral ligament injuries. Long-term clinical outcomes are needed to better understand the effect of ACL treatment on subsequent injuries to meniscus and cartilage, and the development of osteoarthritis. As currently used PROs in ACL research are limited by fixed-length surveys that oftentimes include items of questionable relevance for the young and active populations sustaining ACL injury, the development of new methods and the refinement of current measures of PROs are needed to reduce survey-fatigue and ceiling effects, in turn providing greater validity and enhanced power to discern the effect of treatment interventions. Questions also remain regarding what constitutes the ideal RTS testing battery, the best implementation and use of psychological readiness testing, and the biologic assessment of healing and recovery. As in past meetings, the 2019 Panther Symposium provided a venue at which the current state of ACL injury and management could be openly discussed and from which clinically actionable statements were issued. Equally important, the Panther Symposium was a reminder of our commitment to life-long learning as an international body of practitioners and researchers seeking to optimize patient care. In an increasingly sophisticated, global health-care climate in which emerging technologies are expected to provide the right treatment, to the right patient, at the right time, and for the right price, meeting this challenge in treating ACL injuries requires an approach that is anatomic, individualized, and value-based.

Compliance with ethical standards

Conflict of interest The authors declare no conflicts of interest relevant to this manuscript.

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