ABSTRACT

Interaction Syndrome; an Acute Surgical Disease in Elite Rowers
1. ORTHOPAEDICS ACT, Australia
2. MELBOURNE ORTHOPAEDIC GROUP, Monash University Department of Surgery
3. VICTORIAN INSTITUTE OF SPORT

- Interaction syndrome is a common pathology in the forearm of rowers which can limit their participation in training and racing. Interaction Syndrome was described as pertontendinous entrapments by Nelson Howard in 1937. Theories of pathogenesis include traumatic or stress-induced tenosynovitis, thenovaginitis and compartment syndrome. In this report, we demonstrate the pathology of the condition to be a classical response to first compartment hypertrophy producing an attrition synovial disruption of the sheaths over extensor or radialis longus (ERL) and or extensor carpi radialis brevis (ECRB), resulting in the classical "audible crepitus" that defines this condition
- Typical management includes a protracted period of conservative treatment with rest, activity modification, splitting, and the use of corticosteroids or topical topical anti-inflammatory. Classically the decision to perform a surgical release is based on failure of conservative treatment. Typically at the expense of significant lost training time.
- We present a case series of six elite Australian rowers, four male, two female. Aged between 20 and 29 years of age with interaction syndrome who underwent operative intervention to reduce interruption to training schedules prior to career goal events. Prior to the decision to operate, each athlete underwent a standardized protocol of corticosteroid injection and splitting. Physiotherapy techniques included soft tissue massage through the muscle bellies, radial nerves, flexing, and compartments. Oral non-steroidal anti-inflammatory drugs were used in each case. The athletes lost between 20.3% and 41.1% of available training time for their crew for that international rowing season.
- The presentation will include intra-operative photos, specifically drawn diagrams and histology results explaining the pathogenic mechanism of this rowing injury. The operative and post-operative procedures are discussed in detail. The number of days to commence on-water training varied between five and eight and all cases had a successful return to rowing competition. One athlete had a recurrence of symptoms due to an unrelated trauma which resulted in their retirement. Three athletes won medals at their season pinnacle event between four and eight weeks post operatively.

Criteria of Rowing Technique Effectiveness
1. BIOROW LTD

- Rowing style can be defined in respect to a rower's ability to coordinate their use of oars and trunk.
  - This study describes rowing style across all boat types using numeric criteria in a large sample of rowers.
- Oar angles, seat and trunk positions were measured on-water using BioRowTel system (www.biorow.com). 1473 crews of various rowing abilities were measured. Sample size was 4030 rowers (2837 males) and 2794 data samples. All crews performed a step test with stroke rates from 20-44 min-1. Data samples were time-normalized, averaged and used for calculation of discrete indicators. 1) Catch Factor (CF) was defined as the time difference between moments when the seat (Tsc) and the handle (Th) change direction at the catch. CF (ms) = Tsc - Th. 2) Rowing Style Factor (RSF) was the ratio of displacement of the seat (Ls) to handle (Lh) during the first 20% of the drive from catch to "transition point". RSF (%) = Ls / Lh. 3) Finishing Factor (FF) is the time difference between moments when the trunk (Tf) and the handle (Th) change direction at finish. FF (ms) = Tm - Th. 4) CF was more negative in oar types categories than in sculling. 23/95 vs. 6/7 ms in sculling. RSF was lower in sweep than in sculling. 37/48 vs. 78.3% in sculling. FF was similar between rowing categories. 38 ms. There was a tendency for larger boats to be associated with more negative CF and lower RSF. CF increased with stroke rate, while RSF approximated 76% from 20 to 36•min-1, then decreased to 72% at 44•min-1. There was an inverse relationship between stroke rate and FF stroke rate.
- There was a weak relationship between CF and RSF (r=-.34, p<.001), which suggests they are slightly correlated, but not functionally related. When the above data set was compared against a sub-sample of Olympic standard rowers, they had more negative CF and lower RSF. CF was significantly lower in sculling. 72.9 ms vs. -12.9 ms in sculling, both p<.001 and higher RSF (82.9%, 83.8% both p<.001). This suggests that Interaction Syndrome is a common pathology in the forearm of rowers which can limit their participation in training and racing.
- The aims of this study were to examine: 1) Prevalence level of Interaction Syndrome in the Australian Rowing Team during the 4-year Rio Olympiad (October 2012 to September 2016). Rowing injury and illness data were prospectively collected via an electronic health record (Athlete Medical System, AMS) and were recorded by team doctors and physiotherapists. Athletes have provided consent to storage and use of their medical record and for participation in this research. Ethics approval was granted by the Australian Institute of Sport.
Is the Stomach's Ability to Empty Glucose Drinks Compromised during One Hour of Moderate Intensity Ergometer Rowing?  
1. OXFORD BROOKES UNIVERSITY, Oxford, United Kingdom

Much of the physiological benefit gained from drinking carbohydrate solutions during exercise is related to the ability of the stomach to deliver fluid and energy to the small intestine for absorption. While intense exercise (≥75% VO2 max) can delay gastric emptying compared to resting conditions, there is no difference in emptying rates between cycling and running. However, the effect of rowing on gastric emptying rates is unclear. Therefore, we compared the gastric emptying rates of rowers at rest and during both moderate intensity rowing and cycling.

With local ethics committee approval and after statistical power tests, seven male rowers (age: 25 ± 4 yrs; height: 184 ± 11 cm; mass: 81 ± 11 kg; VO2 peak 47.0 ± 5.1 ml/min) who succeeded in passing an orogastric tube to a suitable stomach depth (assessed using a water recovery test) completed all parts of the study. Next, subjects completed separate cycling and rowing ergometer step tests to fatigue (7 ± 4 min stages) to determine mode-specific VO2 peak and the work rates associated with 70% VO2 peak. All subjects completed 1 hour at 70% VO2 peak on a rowing and cycling ergometer (randomized order) and on a final occasion while subjects remained seated at rest for 1 hour. Each subject was tested at the same time of day and the interval between successive trials ranged from 3 to 7 days. After intubation, all three trials started at 0 mins with a rapid 600 ml infusion of an 8% glucose solution delivered to the stomach through the sample tube. The volume of drink remaining in the stomach was assessed every 10 mins using the doubling sampling aspiration technique with dye dilution. Data was assessed using repeated measures ANOVA.

There were no differences for drink volume at any time point between trials and ~95% of the initial drink volume had emptied from the stomach by 60 mins (rest: 22 ml; rowing: 34 ml; cycling: 41 ml; P > 0.05). There were also no differences in half-emptying times between trials (rest: 18 mins; rowing: 19 mins; cycling: 21 mins; P > 0.05). We conclude that the ability of a rower’s stomach to deliver a glucose drink for intestinal absorption is unaffected during moderate intensity rowing in comparison to either cycling at the same relative intensity or resting conditions.

Measurement of Maximal Accumulated Oxygen Deficit in Rowing  
1. POSTDOCTORAL RESEARCHER, University of Tsukuba, Japan
2. CENTER FOR BRAIN AND HEALTH SCIENCES, Aomori University, Japan
3. FACULTY OF HEALTH AND SPORT SCIENCES, University of Tsukuba, Japan

The purpose of this study was to investigate whether accumulated oxygen deficit (AO0D) would reach its maximal level (Maximal Accumulated Oxygen Deficit: MA0D) during a short exercise bout in rowing.

Sample size of 15 was recommended to detect a difference corresponding to small effect size (probabilities of type I and II error were set as 0.05 and 0.2, respectively). However, 14 male university rowers (height: 173 ± 5 cm, body mass: 69.3 ± 7.4 kg, age: 20 ± 1.2 yrs) participated in the study. The subjects performed incremental tests on a rowing ergometer to obtain an equation to predict oxygen uptake from power output and physical activity level estimated by tri-axial accelerometer on rower's back as explanation variables, which enable to estimate oxygen demand according to power output and rower's body movement. thereafter the participants performed 2 min, 1 km, 1.5 km, and 2 km trials with at least 48 hours rest between each exercise and A00D in each trial were calculated by subtracting measured oxygen uptake from oxygen demand estimated by extrapolating power output and physical activity level measured during each trial on the equation obtained from the incremental tests. ANOVA with Bonferroni correction was used to compare A00Ds among the trials.

Significant difference of A00D was detected between 2-min trial (5.2 ± 1.1 L of oxygen equivalent: L) and 1-km trial (4.8 ± 1.1 L of oxygen equivalent: L), but not among 1.5-km trial (4.8 ± 1.1 L of oxygen equivalent: L) and 2-km trial (5.9 ± 2.1 L of oxygen equivalent: L). MA0D, which was defined as the highest value of A00D within each subject, was 6.4 ± 2.1 L of oxygen equivalent: L, and A00D in 2-min trial was corresponding to 83.7 ± 8.7% of MA0D. This attainment of A00D in 2-min test was negatively correlated with MA0D (r = -0.87, p < 0.01), suggesting that 2-min test might be too short to exhaust anaerobic capacity for rowers who had higher MA0D. We conclude that university level rowers might not be able to engage their anaerobic capacity in 2 min maximal effort.

Optimization of the Geometry of a Rowing Seat Using FE Simulation and 3D Print  
1. UNIVERSITY OF APPLIED SCIENCES ULM / HOCHSCHULE ULM

Intense rowing trainings or long rowing tours often are accompanied by discomfort and sometimes even health issues. These can be induced by standard rowing seats causing circulation-restricting pressure on the buttocks of the rower. Is there a possibility to reduce these issues by optimization of the geometry of the rowing seat? This paper introduces a method usually used in car or office seat design – optimization based on pressure distributions – applied to rowing seats. The Finite Element human body model THUMS 5.0 and the simulation tool LS Dyna were used to simulate the distribution of the contact pressure at the interface of the body and different seat geometries. An optimization of the surface geometry of the seat was performed. The final simulation using the optimized seat surface showed a significant reduction of the maximum interface pressure. Design directions for the improvement of the seat geometry were defined based on this optimization. These directions include a smooth seat surface without holes. The seat surface should be adopted to the deformed buttock surface of the rower.

These guidelines were used to design the geometry of rowing seats for two rowers. 3D printing was used to produce prototypes with the improved geometry for these rowers.

Development of Stroke Rate in Rowing from 2013 to 2018  
1. INSTITUTE FOR APPLIED TRAINING SCIENCE, JAT Leipzig

The purpose of this study was to check whether the stroke rate (SR) in rowing has increased within world class athletes over the past six years. The boat speed in rowing is the product of the SR and distance per stroke. The higher the SR at the same stroke length, power and conditions, the higher the boat speed.

However, the relation between boat speed and SR is not proportional. Hence, a higher boat speed can only be achieved to a certain level by increasing the SR (Kleshnev, 2016). Nevertheless, the stroke frequency is essential for the rowing performance as it is less influenced by external conditions than the boat speed or the propulsion per stroke. Therefore, this longitudinal study shall observe the SR per different events.

SR and boat speeds are automatically recorded by Swiss Timing (Corgenix, Switzerland) at least every 30 meters. Thus, it is possible to calculate the average values of the SR for the entire 2,000-meter race track and for selected sections. Global Positioning System (GPS) data were evaluated at almost all World Rowing World Cups and World Rowing Championships from 2013 to 2018 for the A-finalists of all Olympic boat classes. The data were analysed using a variance analysis and an independent sample t-test.

Initial results show that the SR has increased significantly between 2013 and 2018. Considering only the data of the medal winners of all boat classes, the average stroke frequency over the entire 2,000-meter test has increased significantly (from 2013 to 2015: N = 396 tests; 27.7 (2010 to 2018: N=337; p = 0.001; d = 0.455). In the second part of the race there is a slightly higher frequency in the 2,000-meter test. Some differences in the development of the SR can be observed between the boat classes.

Further research on individual boat classes, gender differences and race sections will be presented at the conference and consequences for training will be discussed.
Way to the Top - Relationship between Junior and Elite Success in Rowing
1. INSTITUTE FOR APPLIED TRAINING SCIENCE, JAT Leipzig

- Often talent promotion systems are based on the assumption of a progressive trend in performance development from a novice athlete to junior and senior competition levels (Vaerst, Glied, Vaerst, & Philippaerts, 2009). Previous studies show that the correlation between junior and elite success varies strongly between sports (Hoffmann & Wuelf, 2013). The aim of this study is to analyse this relationship in rowing pros. and retrospectively.

- The study is threefold First, to identify national promotion strategies for long-term athlete development correlations of medal rankings (mean=2014-2018) at Junior World Championships (JWC) and Under 23 World Championships (U23 WC) and World Championships Olympic Games (WC/OG) were calculated. Second, participation and success in U23 WC and WC/OG of medalists in 2009 (N=130) were analysed on descriptive level. Third, WC/OG and U23 WC results of medalists in 2016 (N=140) were analysed net respectively.

- Medal rankings of JWC, U23 WC and WC/OG correlate moderately (r = ±0.32-0.59). 42 % of WC/OG medalists make the leap to WC/OG, almost all of them to intermediate stage U23 WC. The probability of participation in WC/OG is greater for small boats WC/OG medalists than for big boat medalists (p = 0.05). From junior to senior level, the change between small boat and big boat is more likely than the change between sweep and scull. 37% of the WC/OG medalists moved to WC/OG in U23 WC, Parties in JW reach elite level about two years earlier than non-participants (t=[55] = 0.008, d = 1.37).

- The generalized assumption of participation in international competitions as a prerequisite for elite success was not confirmed. U23 WC seem to be an important milestone in rower’s career development. The results are discussed in detail for women/men, scull/swEEP and small boats/big boats. Finally, data are analysed regarding the correlation between junior and elite results.

Extended Standard Echocardiography in Pre-Participation Screening of Athletes
1. DEPARTMENT OF CARDIOLOGY, University Hospital Leipzig, Germany

- Echocardiography is an important part of the investigation of competitive athletes. Since echocardiography cannot sufficiently detect cardiac-risk factors, an echocardiographic examination during the first investigation of squad athletes is required by some of the sports federations. Therefore, an extensive standardized protocol for consistent exclusion and monitoring of cardiac abnormalities is necessary at the beginning of the athlete’s career.

- As competitive athletes should have a normal cardiac morphology and function, the following issues were evaluated. Firstly, we introduce an extended standardized transthoracic investigation. Secondly, we describe unusual findings inside our cohort and discuss the potential pathological value for the athlete’s career and physical health.

- The extended standardized echocardiographic examination in our hospital has been performed since 2015. It contains the proposed transthoracic investigation in adults according to European recommendations, as well as additional sonographic examinations of the heart. This extensive echocardiographic examination has been performed since 2015.

- In the present study, 55 male athletes have been examined by comprehensive transthoracic echocardiographic examination as described above. In three (5%) patients suspected reflexes with the following potential sudden cardiac death cases were found. A high spatial acoustic window was found in two athletes, one of them with additional indicators for hypertrophic cardiomyopathy. One athlete presented regional deformation abnormalities due to myocarditis. Besides, one patient showed slight aortic regurgitation without aortic root abnormalities and another patient presented left ventricular hypertrophy due to arterial hypertension. Moreover, four patients showed inductions of an athlete’s heart.

- Nine (16%) patients showed explicit cardiac abnormalities. Out of them, five findings had pathologic value and implied medical therapy and frequent control investigations respectively. Echocardiographic investigation requires a high level of accuracy, especially in sports medicine. Therefore, the standardized examination should be extended with respect to image acquisition as well as additional analyses by post processing as shown to ensure comparable quality of data inside various sports medical facilities.

Sonographische Verlaufskontrollen bei Muskelverletzungen im Profi-Sport – Bedeutung und Limitationen
1. UNIVERSITY OF HAMBURG

- The racing shell is propelled forwards by the rower acting as a one-arm lever with the footrest on the blade and lever application at the handle. The handle, arms and shoulders rotate around the oar, which results in a movement asymmetry in sweep-rowing. Because of the different hand positions at the handle, a distinction is made between outside-arm (OA) and non-outside-arm (nOA) and the respective side (shoulder and leg). The nOA pulls further outboard and with a longer lever closer to the OA. Hypothetically, during the dominant nOA pull, a higher torque on the handle and greater asymmetry of the stretcher forces is expected.

- The study investigated male elite athletes of the German Rowing Federation (light- and open-weight, body height 190±10 cm, body mass 81±9 kg, N=32) in a cerebellous force. The forces at the handle, nOA and stretcher of the outside- and non-side-arm leg (OL and nOL), were measured using the german measuring system. The effects of dominant OA pull in comparison to baseline (usual rowing) were variance-analytically examined.

- The results confirm the hypothesis, because in comparison to baseline (normal rowing, 20±5 min), the dominant OA pull produced an increased nOA force (283±39 vs. 286±39 N, p = 0.001), higher stretcher force of the nOA (294±51 N vs. 331±31 N, p = 0.01) as well as lower stretcher force of the OL (234±97 N vs. 211±64 N, p = 0.003). Dominant OA pull tends to increase the handle power 166±139 W vs. 795±131 W, p = 0.06) but also asymmetries of stretcher force (23±22% vs. 39 ± 24%; p = 0.001).

- Dominant nOA pull increased propulsion of the handle force. Here it should be noted that the increased asymmetry of stretcher force leads to an asymmetric load on the lumbar pelvic region and thus increases the risk for back pain. Consequently, dominant OA pull must be muscle prepared with strength training and its amount in on-water training should be controlled to avoid pain in the lumbar pelvic region.

Exploratory Study on Bone Mineral Density in Women Rowers before and after Water Season
1. FACULTY OF KINESIOLOGY, University of Calgary, Calgary, Alberta
2. FACULTY OF ENVIRONMENTAL DESIGN, University of Calgary, Calgary, Alberta
3. DEPARTMENT OF STATISTICS - MATHEMATICS, University of Calgary, Calgary, Alberta

- Sweep rowing is a transport sport where athletes on alternating sides of about use a single-seat propeller to propel a crew through the water. Athletes likely experience unequal forces on each side of their body due to the one-sided nature of sweeping. This discrepancy in physical stress has been observed to contribute to muscle imbalances (Janssen et al., 2009), but the potential to produce disparities in bone mineral density (BMD) has not been investigated. This study investigated if on-water sweeping affected leg BMD in trained female rowers. The fall/winter macrocycle in Calgary, Alberta, involves a six-month dry-land season with equal bilateral activities of ergometer, resistance and cross training, followed by spring/summer macrocycle of four to six-months of sweep on water training (seven water sessions/week). National and/or international competitive female (N=8) rowers (mean SD years) were measured on the first and last sweep season. The differences in BMD were assessed using a two-sample t-test and the difference between the inside and outside leg.

- Four water sessions/week were performed in the on-water training period. The fall/winter macrocycle involved a six-month dry-land season with equal bilateral activities of ergometer, resistance and cross training, followed by spring/summer macrocycle of four to six-months of sweep on water training (seven water sessions/week). National and/or international competitive female (N=8) rowers (mean SD years) volunteered to have two Dual-energy X-ray absorptiometry bone scans performed within the first month of on-water training (pre) and at the season end (post). Sweeper were identified as either ‘star’ (n=1) or ‘port’ (n=4) and recorded their inside (on the same side as their oar) outside (on the opposite side as their oar) leg. Star (n=1) had higher BMD in both legs post (left inside 191 ± 210 and right outside 122 ± 234 g/cm2) and the difference between the inside and outside leg was similar pre and post (0.03 ± 0.003 g/cm2). Port (n=4) had lower inside (n=3) and outside leg BMD (n=1) compared to the inside 1.06±0.2 cm2. The differences inside to outside pre (n=3) were less than post (n=2; 0.03±0.02 cm2). Future research with a larger sample size is needed before such imbalances can be identified as a mechanism for injury risk.
A Comparison of the Physiological Responses to Identical Power Outputs on the Concept II BikeErg and Concept II RowErg

Turner K., McCarthy A., Rice A.

1. ULSTER UNIVERSITY, Northern Ireland
2. UNIVERSITY OF CANBERRA, Australia
3. ROWING AUSTRALIA, Australia

Rowers use cross-training to supplement the volume of training required to create local and central adaptations as well as improve rehabilitation. Stationary cycling is often used for rehabilitation as it reduces compressive forces on the thoracic cage and intervertebral discs as it forces the body’s load through the lumbar spine.

Our group has previously shown marked differences in physiological responses for the same rowers on a Concept II RowErg (RowErg), Concept II BikeErg (BikeErg) and Concept2 Inc. (US) and WattBike (WR; WattBike Pro; WattBike, UK) at identical power outputs (Lindenthal, et al 2018). With the introduction of the CII BikeErg (BikeErg, Concept II BikeErg, Concept2 Inc. US) we presumed that the similar resistance design of the two CII ergometers would produce more similar physiological responses than our previous study.

Ten well trained, local male rowers (mean ± SD age: 20 ± 2.7 years, body mass: 79.3 ± 9.8 kg) were recruited for this study. On a single day, two submaximal incremental tests consisting of six minutes workload interspersed with 2 min recovery periods were undertaken on a RowErg and a BikeErg. Workloads were calculated as being 35%, 67.5%, 73.7% and 87.5% of their most recent 2000m RowErg score and were matched on both ergometers. Trials were separated by 45 mins and diet was controlled prior to each ergometer trial. Stroke rate, cadence and physiological variables (Volume of O2 consumed, Volume of O2 exchanged, Minutes of Ventilation, Respiratory Exchange Ratio, Heart Rate) were measured during the final 2 min of each workload as well as lactate concentration and rating of perceived exertion were measured during the recovery period.

Results: RowErg produced significantly higher values for VO2, VE, HR than BikeErg, RPE was higher for all workloads on RowErg but was not significantly different from BikeErg. While rowing VO2 were -0.71, -0.71, higher, HR was 155/min higher and VE was up to 301, min higher during heavy exercise compared to cycling. BLAs were similar for workload 1 and 2 but higher for workload 3 and 4 on the RowErg with a <3 mmol L-1 difference during heavy exercise.

The data shows that identical wattages on both rowing ergometers require a considerably higher metabolic load compared to the BikeErg despite similar ergometer design from the same manufacturer. These data are consistent with our previous work using a RowErg and a BikeErg and strengthen the concept that the RowErg may not be accounting for all the work done during a full rowing stroke cycle, especially the power required during the recovery phase of the rowing stroke.

Incidence of Low Back Pain in Slovenian Rowers

Planinic N., Hauptman N., Zapet P.

1. INS INSTITUTE FOR MEDICINE AND SPORTS, Ljubljana, Slovenia
2. FACULTY OF MATHEMATICAL AND STATISTICAL SCIENCES, University of Primorska, Koper, Slovenia

Introduction: Back pain is one of the major health problems among rowers. It leads to significant training and competition absences. In older rowers, it is often associated with degenerative diseases of intervertebral discs. Ligaments and intervertebral discs while rowing are subjected to high tensile stress, which may lead to possible infection, tumor, spondylolisthesis, segmental instability or fracture. Not only the incidence of back pain is high it also presents very soon in younger rowers. Therefore, we have decided to study the occurrence of back pain in Slovenian rowers and find potential risk factors in different age groups.

Methods: 86 professional competitive rowers from different clubs in Slovenia participated in the retrospective study. 56 of the rowers were men aged 11 to 28 and 30 of them were women aged 12 to 28. Each of them was asked to fill in a questionnaire based on Standardized Nordic questionnaire for assessment of skeletal muscular symptoms in working population. The questionnaire was fitted and adjusted to focus on back pain in rowing. Data was collected in 2016 and was got signed informed consent from all participants. Participants signed the informed consent for minors. Bi- square test was used to determine the differences in categorical variables and T-test was used to determine the differences in continuous variables.

Results: Over last 12 months 27% of young juniors aged under 15 years (U 15) suffered from back pain while the percentage increased in older juniors aged under 19 years (U 19) to 52.6% and to 52.9% in elite rowers. 68.3% of rowers have suffered from back pain at least once since the age of 15. Risk factors are different in different age groups. Male gender proved to be an important risk factor for back pain among junior rowers (p=0.008). Hours of training per week and hours of training per day also proved to be important in the previously mentioned population (p=0.027 and p=0.008). Number of training hours on ergometer was confirmed to be an important factor in younger juniors (U 13, p=0.001) and older juniors (U 19, p=0.009). Choice of rowing style is important among junior rowers (p=0.005) and presence of skeletal muscle diseases was confirmed as an important factor in the population as a whole (p=0.001), but especially in young juniors (U 15) (p=0.012).

Conclusion: Our study showed that incidence of back pain increases with age until older juniors (U 19) and that approximately one out of two rowers suffers from back pain at least once - month period. A significant difference is shown between male and female gender among junior rowers. There are other risk factors in different age groups that influence the occurrence of back pain. Because of high incidence and early set of back pain rowers in prevention is very important.

The Occurrence of Rib Stress Fracture among Slovenian Rowers

Planinic N., Staumbersger N., Zapet P.

1. INS INSTITUTE FOR MEDICINE AND SPORTS, Ljubljana, Slovenia
2. FACULTY OF HEALTH SCIENCES, University of Primorska, Koper, Slovenia

Introduction: Lack of data in clinical practice often leads to false or late diagnosis of the stress fracture of ribs, which is the main reason for the loss of training hours. It may be more likely to occur in elite rowers than in non-elite rowers and in most cases, it occurs in ribs four to eight, mostly along the anterolateral/lateral rib cage. In this study, we have analyzed the occurrence of rib stress fracture among rowers in Slovenia and the potential risk factors.

Methods: The study involved 47 rowers, who are training at the competitive level. 15 of them were among rowers in Slovenia and the potential risk factors. We have based our questionnaire on the standardized Nordic questionnaire for the assessment of skeletal muscular symptoms in working population, which was customized for the working population among rowers. We performed an observational, cross-sectional study in elite rowers with a descriptive and analytical assessment. All Athletes of the national elite team and U23 team (n=55) were asked to participate in the study. Only symptomatic rowers were recruited. Finally, 20 athletes (19 male and 1 female) gave their written consent. In November 2017, We analyzed hip joints of these 20 symptomless elite rowers (9 males / 11 females, 18-23 years). A 20-year-old female rower was excluded in our study. All athletes were trained regularly for at least two weeks to minimize recall effects. In every case the grading was performed independently. Findings were compared between sweep-oars (inner and outer hips) and skulls.

Results: Among 13 elite rowers, two men suffered a stress fracture of ribs (15, 38%). There were no stress fractures in other categories. We analyzed different risk factors among elite rowers (gender, weight, number of months of competitive rowing, average training hours per week and per day, average training hours on water and on ergometer per week, average time of stretching exercises before and after training session) but none of them was statistically relevant.

Conclusion: We had two rib stress fractures among elite rowers and none among younger rowers.

Discussion: Rowers reported the stress fracture during intensive and frequent training, so we can imply that the number of hours and the intensity of training are potential risk factors but we could not find statistically relevant correlation. Our results have limited relevance because of small sample but the literature supports our findings of higher incidence among elite rowers compared to younger categories.

Cartilage Alterations in Asymptomatic Elite Rowers are Dependent on Technique: A T2 Mapping Study


1. DEPARTMENT OF ORTHOPAEDICS AND TRAUMA SURGERY, University Hospital Essen, Germany
2. DEPARTMENT OF ORTHOPAEDICS, University Hospital Duesseldorf, Duesseldorf, Germany

Introduction: Previous studies demonstrated a high amount of cartilage degeneration in hips of asymptomatic elite rowers. Because the center of rotation is located more superolateral compared to skew-styles, the study purpose was to assess whether the location of cartilage alteration is dependent on rowing technique.

Methods: We performed an observational, cross-sectional study in elite rowers with a descriptive and analytical assessment. All Athletes of the national elite team and U23 team (n=55) were asked to participate in the study. Only asymptomatic rowers were recruited. Finally, 20 athletes (9 male and 11 female) gave their written consent. In November 2017, We analyzed hip joints of these 20 symptomless elite rowers (9 males / 11 females, 18-23 years). A 20-year-old female rower was excluded in our study. All athletes were trained regularly for at least two weeks to minimize recall effects. In every case the grading was performed independently. Findings were compared between sweep-oars (inner and outer hips) and skulls.

Results: Among 20 asymptomatic rowers, we demonstrated a high amount of cartilage degeneration in hip joints of asymmetrical rowers compared to skew-styles, which is more likely to be located in the central region of the acetabular roof. In both hip joints, we found a statistically relevant difference in cartilage alterations in hip joints of asymmetrical rowers. The mean T2* values were significantly lower (p=0.007) in the central region (P = 0.037) when compared to the inner hips. All hips revealed some degree of morphological alternations. Reader 1 repeated the grading with a time interval of at least two weeks to minimize recall effects. In every case the grading was performed independently. Findings were compared between sweep-oars (inner and outer hips) and skulls.

Discussion: In our study, we demonstrated a high amount of cartilage degeneration in hip joints of asymmetrical rowers compared to skew-styles, which is more likely to be located in the central region of the acetabular roof. The mean T2* values were significantly lower (p=0.007) in the central region (P = 0.037) when compared to the inner hips. All hips revealed some degree of morphological alternations. Reader 1 repeated the grading with a time interval of at least two weeks to minimize recall effects. In every case the grading was performed independently. Findings were compared between sweep-oars (inner and outer hips) and skulls.

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Cardiac Etiology of Exercise Induced Hypoxemia within Elite Athletes

1. CENTER OF SPORTS MEDICINE, Faculty of Medicine in Hradec Kralove, Charles University
2. INSTITUTE OF CLINICAL AND EXPERIMENTAL MEDICINE
3. UNIVERSITY HOSPITAL OF KLOVSKY KLINIKY

Exercise induced hypoxemia (EIH) is a common finding within a group of elite athletes. It is generally thought, that this can occur in the pulmonary circulation. We report on a group of 8 elite athletes with severe EIH (SpO2 below 92%) further examined for the origin of the EIH. The task was to perform differential diagnoses between functional shunts in the pulmonary circulation and cardiac shunts.

Methods: Eight national level endurance athletes (cycling, running and rowing) with severe EIH (SpO2 reproducibly below 92%) have been examined with stress transthoracic echocardiography with injection of agitated saline. The saline was administered via cubital ven during the last two steps of the stress echo protocol and in the presence of the hypoxemia. Differential diagnosis was based on previously published reports for evaluation of cardiac shunts – number of microbubbles and latency (number of cardiac cycles) between the injection and the appearance of the microbubbles in the left heart. Trans-esophageal echo has been performed in the follow up procedure to evaluate the anatomical etiology of the shunt.

Results: Four athletes presented pulmonary etiology of the hypoxemia. Four athletes presented cardiac origin with right to left shunt causing the EIH. Concurrent transesophageal echocardiography discovered one atrial septal defect and three patent foramen ovale (PFO). One athlete out of three with present PFO underwent catheterization closure of the PFO. Follow up exercise testing and stress echo confirmed no signs of shunt and no signs of EIH in that patient. Performance measures of that athlete improved significantly.

Conclusions: Exercise induced hypoxemia is generally thought to be caused by anatomical or functional shunts within the pulmonary circulation. Our findings suggest possibly higher prevalence than originally thought of cardiac etiology of the exercise induced hypoxemia within a group of elite athletes. Successful treatment by catheter based closure device improves performance and eliminates other clinical signs of the right to left cardiac shunt. Further evaluation of larger group of elite athletes with EIH is warranted for better understanding of the real prevalence and possible treatment of the cardiac origin of the EIH.

Influence of Stroke Characteristics on Power Calculation in Wind Brake Rowing Ergometers ORAL

Treff G1, Mentz L1, Steinacker JM1, Mayer B2, Schulz G3, Engleder T3

University of Applied Sciences, Ulm, Germany

Introduction: Standing height (SH) and body mass (BM) are well established determinants of rowing performance, which therefore typically included in most talent identification and development (TID) programs. However, the effect of these variables on long-term career attainment in junior rowers has not been examined. Therefore, we aimed to analyse differences in anthropometric characteristics of elite junior rowers in relation to standardised levels of career attainment and to define normative data ranges.

Methods: Former German Junior National Team rowers (N=910; 399 females) were grouped according to their highest career attainment, i.e. participation in U19- U23- Senior World Championships or Olympic Games (OG). Differences in SH, BM and body mass index (BMI) between attainment levels were analysed using unpaired t-tests and magnitude-based inferences (MBI). Effects of anthropometric characteristics on career attainment were analysed with a proportional odds model (POM). Interquartile range (IQR) of the OG group were used to define normative data ranges.

Results: SH and BMI very likely differed between career attainment in males, the same was found in females for SH and BMI. SH (odds ratio (OR)=1.072; P=0.002) and BMI (OR=1.049; P=0.004) had a significant effect on career attainment in males, as BMI (OR=0.983; P=0.017) and BMI (OR=0.983; P=0.004) had an influence on career attainment in females. BM and SH were 196-196 cm and 84-93 kg in males, 174-194 cm and 66-73 kg in females.

Discussion: Even within elite sample of U19 National Team rowers, anthropometric characteristics at junior age discriminated between, and affect subsequent attainment level. Accordingly anthropometric characteristics of U19 rowers contribute to long-term career attainment. Interestingly, higher BM and BMI of female rowers were associated with lower career attainment, probably due to an impaired power to body weight ratio. Further we provide evidence-based normative data which rule out an anthropometric limitation of junior rowers for career progression to Olympic level. All in all, our data underlining the relevance of anthropometric assessments and their consideration for TID programmes in rowing. As TID is multi-dimensional and partly inherently, anthropometric data should not be used exclusively.