



23rd Annual Meeting of the German Professional Association of Travel Medicine (DFR) Coburg, Germany, 18–19. September 2020

Congress President: Prof. Dr. med. Dipl. biol. Günter Schmolz

Article history:

Otrzymano/Received: 22.07.2020

Przyjęto do druku/Accepted:

23.07.2020

Opublikowano/Publication date:

lipiec 2020/July 2020

Noise exposure and hearing threshold in isobaric hypoxia

Fehrenbacher K.¹, Heussen N.², Porath S.¹,
Opgenoorth B.³, Küpper T.^{1,4}

1. *Inst. of Occupational & Social Medicine, RWTH Aachen
Technical University, Aachen/Germany*

2. *Inst. of Medical Statistics, RWTH Aachen Technical
University, Aachen/Germany*

3. *Hypoxie Centre Opgenoorth, Hilden/Germany*

4. *Medical Commission of the Union Internationale des
Associations d'Alpinisme (UIAA MedCom),
Bern/Switzerland*

Introduction: A previous study showed higher vulnerability of the inner ear in hypobaric hypoxia (high altitude). Isobaric hypoxia is used to reduce the risk of fire. In normoxia regulations are established to recommend noise protection at levels above 80 dB(A) and above 85 dB(A) such devices are mandatory. Goal of this study was to prove whether the higher vulnerability found in hypobaric hypoxia is also true in isobaric hypoxia and

to check whether exhaustive work which decreases SaO₂ further could be a confounding factor. Consequences would be that the threshold of protective gear should be adapted for hypoxic conditions.

Material and Methods: Measurements of the hearing threshold were conducted in different double-blind settings (normoxia, 3000m, 4000m). Audiometry was performed before and after exposure to „white noise“ at 90 dB(A) for 10 minutes. After a pause of 60 minutes the setting was repeated, now with exhaustive exercise (cycle ergometry) during white noise exposure.

Results: Preliminary data show a significant difference regarding the temporary threshold shift with or without exhaustion ($p < 0.0001$). There is also a significant difference regarding hypoxic levels vs. normoxic ones, simulating an altitude of 3000m ($p = 0.0052$) and 4000m ($p = 0.005$).

Conclusions: The ear seems to be at a higher risk when exposed to noise in hypoxic conditions. Since noise induced hearing loss is still one of the most frequent occupational diseases, further studies should reevaluate the thresholds in hypoxic conditions. However, thresholds to use noise protection should be reduced by at least 5 dB(A) to 75 and 80 dB(A), respectively.

Acute mountain sickness (AMS), High altitude pulmonary edema (HAPE) and high altitude cerebral edema (HACE) of foreigners on Everest Basecamp (EBC) Trek – Data from the 2nd ADEMED-Expedition 2011

Haunolder M.¹, Schmitz S.¹, Apel C.², Bertsch D.³, Cerfontaine C.¹, v.d. Giet S.¹, v.d. Giet M.¹, Grass M.¹, Hundt N.¹, Jäger J.¹, Kühn C.¹, Risse J.¹, Timmermann L.¹, Wernitz K.², Küpper T.^{1,4}

1. *Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany*

2. *Helmholtz-Institute for Biomedical Engineering at RWTH Aachen Technical University, Aachen/Germany*

3. *Dept. of Cardiology, Catholic Hospital Marienhof, Koblenz-Montabaur/Germany*

4. *Union Internationale des Associations d'Alpinisme (UIAA MedCom), Bern/Switzerland*

Aim of the study: To evaluate the incidence of acute mountain sickness (AMS), high altitude cerebral (HACE) and pulmonary edema (HAPE) on the Everest Basecamp Trek in Nepal.

Material and Methods: 350 subjects received a questionnaire and physical to detect AMS, HAPE, or HACE. Manifest AMS was assumed for a Lake Louise AMS Symptom Score (LL-AMSS) of ≥ 3 points. Retrospectively the data were evaluated to the revised LL-AMSS (2018). Significance was calculated via Chi Square Test.

Results: The LL-AMSS showed a rate of 25.1% (n=88) for AMS. Retrospective analysis with the new LL-AMSS 2018 revealed an incidence of 5.7% (n=20) for ≥ 3 points, equivalent to mild AMS. Headache and ≥ 1 AMS symptoms were found in 17.1% (n=60). Additional risk factors for HAPE were found in 30 participants (8.6%) and 5.4% (n=19) fulfilled criteria of HACE. Only 96 trekkers (27.4%) were entirely free of typical AMS symptoms. Women were significantly more affected than men ($p \leq 0.001$), other implied risk factors for AMS could not be confirmed.

Discussion: Compared to older studies AMS rates are declining, probably by better pre-travel information. The high rates for HACE and HAPE risk factors in this trial are alarming and may be explained by rising self-medication rates (e.g. acetazolamide 17% in this trial) and lesser days for acclimatisation. Warning signs are obscured and proper acclimatization or even descent is not conducted. Especially in guided treks a tour leader might not be considerate of the individual trekker and force the entire group to ascent further.

Conclusion: Every trekker should consult a physician prior to departure, ideally a travel medicine specialist. Travel plans must

be adjusted individually, especially concerning adequate time of acclimatisation. Pre-travel medical advice needs to include information about AMS, HACE, HAPE, and self-medication.

Cardiovascular risk profiles and pre-existing conditions in trekkers – An epidemiological study in the Solo Khumbu region, Nepal. Data from the 2nd ADEMED-Expedition 2011

Haunolder M.¹, Schmitz S.¹, Apel C.², Bertsch D.³, Cerfontaine C.¹, v.d. Giet S.¹, v.d. Giet M.¹, Grass M.¹, Hundt N.¹, Jäger J.¹, Kühn C.¹, Risse J.¹, Timmermann L.¹, Wernitz K.², Küpper T.^{1,4}

1. *Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany*

2. *Helmholtz-Institute for Biomedical Engineering at RWTH Aachen Technical University, Aachen/Germany*

3. *Dept. of Cardiology, Catholic Hospital Marienhof, Koblenz-Montabaur/Germany*

4. *Union Internationale des Associations d'Alpinisme (UIAA MedCom), Bern/Switzerland*

Aim of the study: Finding the right pace. Our intention was to show that adventure and physical activity is generally achievable by everybody meeting certain precautions.

Material and Methods: The participants (N=350) answered a questionnaire, covering general information about the participant, travel preparations, nutritional and health-orientated behaviour, medical history, current health status, issues during the trek and family anamnesis. The following basic physical examination contained heart and lung auscultation, blood pressure, peak flow, orthopaedic tests, a urine test and a cholesterol test.

Results: 60.5% of the participating trekkers were male and 35% female, the mean age was 42.7 years (17–76). 44.5% had one or more pre-existing conditions, excluding acute conditions and symptoms due to acute mountain sickness. Symptoms related to high altitude were found in 61.4%. 95.1% of the participants were positive for at least one major cardiovascular risk factor. The mean number of major risk factors to be found in our participants was 1.7. Concerning minor risk factors 95.1% were positive for at least one, the average was 1.9 minor risk factors. Pre-existing conditions rarely caused problems on the trek.

Conclusion: Trekking can generally be recommend also with minor cardiovascular risk factors or pre-existing conditions if certain prerequisites are met, especially adequate workload and acclimatization. Circumstances of organised trekking groups were sometimes alarming and prevented the impaired trekkers from choosing their own time and speed, but drug intake was

promoted. Here special advise of the trekkers is strongly recommended.

Medical problems independent from altitude in trekkers hiking to Everest Base Camp – Data from the 2nd ADEMED-Expedition 2011

Haunolder M.¹, Schmitz S.¹, Apel C.², Bertsch D.³, Cerfontaine C.¹, v.d. Giet S.¹, v.d. Giet M.¹, Grass M.¹, Hundt N.¹, Jäger J.¹, Kühn C.¹, Risse J.¹, Timmermann L.¹, Wernitz K.², Küpper T.^{1,4}

1. *Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany*

2. *Helmholtz-Institute for Biomedical Engineering at RWTH Aachen Technical University, Aachen/Germany*

3. *Dept. of Cardiology, Catholic Hospital Marienhof, Koblenz-Montabaur/Germany*

4. *Union Internationale des Associations d'Alpinisme (UIAA MedCom), Bern/Switzerland*

Aim of the study: The Everest Trek in Nepal attracts a broad spectrum of alpinists to a high altitude setting. To examine which pre-existing conditions they bring along and which problems they encounter along the way was the objective of the study.

Material and Methods: 350 subjects received a questionnaire and basic physical examination, including measurement of blood pressure, heart rate and oxygen saturation. Symptoms were asked for with yes-/no-answers and could be specified via free text. Significance was calculated via Chi Square Test and U-Test.

Results: 79.4% (n=276) had at least one newly developed health issue in the given categories. Pain was the most frequently mentioned symptom (34.5%, n=120) with headache being the most frequent localisation. The intensity was described with an average of 3.5 points on NRS scale. Diarrhoea was mentioned by 50 participants (n=14.3%) and lasted for 1-2 days in most cases. Injuries concerned mostly the lower extremities and were minor. Episodes of fever (n= 22, 6.3%) were seldom confirmed by measurement of temperature and lasted for 0.5 – 2 days. Cold symptoms and respiratory tract infection affected 10 participants (2.9%). Other health issues were rare.

Conclusion: Acute medical conditions are frequent but seldom severe. Often self-medication of symptoms or minor injuries is possible, if such equipment is carried along. Medical care for more severe conditions or rare problems is seldom available. Each traveller should be advised how to use the basic emergency equipment properly.

Polychlorinated biphenyls (PCB) and informal e-waste recycling

Kaifie A.¹, Schettgen T.¹, Bertram J.¹, Löhndorf K.¹, Waldschmidt S.¹, Felten M.K.¹, Kraus T.¹, Fobil J.N.², Küpper T.¹

1. *Institute for Occupational, Social, and Environmental Medicine, Medical Faculty, RWTH Aachen University, Aachen/Germany*

2. *Department for Biological, Environmental, and Occupational Health Sciences, School of Public Health, University of Ghana, Legon, Accra/Ghana*

Introduction: Polychlorinated biphenyls belong to the group of persistent organic pollutants and have been widely used as dielectric substances in capacitors and transformers in the electrical engineering sector and as joint sealing compound in the construction sector. PCBs are suspected of causing toxic effects on human health, such as dermal, metabolic, and immunologic disorders and diseases. In this study, we examined PCB blood level concentrations of workers from the informal e-waste recycling sector at Agbogbloshie, Ghana.

Results: Altogether, blood from n = 88 e-waste workers and n = 196 controls has been analyzed for the indicator congeners PCB 28, 52, 101, 138, 153, and 180 using mass spectrometry. A significant statistical difference could be demonstrated for PCB levels of lower chlorinated PCBs (PCB 28, 52, 101) in the e-waste workers in comparison to the control group (for all congeners $p < 0.05$), as a marker for occupational exposure. 28.4% of the e-waste workers exceeded the German reference values (BAR) for PCB 28 and 25% for PCB 52. In the control group, only 4.1% exceeded the BAR for PCB 28 and 3.1% for PCB 52. However, PCB levels did not exceed the BAT value indicating adverse health effects.

Conclusions: Although, task specific elevated PCB levels could be observed, adverse health effects are not going to be expected. However, the elevated PCB levels indicate an insufficient work hygiene. Therefore, safety trainings and the provision of personal protection equipment are necessary to protect the worker's health.

Are Sightseeing or Training Flights Safe in the Era of Corona Virus? Virus-Spread in General Aviation Cockpits

Keimer J.¹, Bergmann O.¹, Dahmann P.¹, Janser F.¹, Machado P.², Page H.¹, Pluta E.¹, Saretzki C.², Stübing F.¹, Küpper T.²

1. Faculty of Aerospace Engineering, FH Aachen University of Applied Sciences, Germany

2. Institute for Occupational and Social Medicine, RWTH Aachen Technical University, Germany

Aim of the study: Investigation of the cabin airflow in smaller General Aviation aircraft regarding the distribution of breathing air between the aircrew members and passengers.

Material and Methods: The cabin's ventilation system of a typical 4-seater General Aviation aircraft, type Morane Saulnier MS893E, was used to reproduce the cockpit airflow during flight. Inflight measurements were performed to validate the model. For visualization, the ventilation airstream in the cabin was marked with smoke. The flow velocity was measured in three axes at various points using a thermal anemometer. To evaluate the air exchange rate the circulation coefficient was calculated by using the measured velocities.

Results: The airflow velocity was 8.5 m/s at the nozzle outlet during the ground tests and 10.0 m/s inflight. The calculated cabin air exchange rate was 0.5 l/min and 0.6 l/min, respectively. The visualized airstream in the cockpit showed no crossflow, which indicates that there is no or minimal aerosol transport between the two pilots. The velocity measurement between the heads of the test persons also indicates an insignificant component in the y-direction. The visualization shows that there was nearly no flow towards the backseaters.

Conclusion: Preliminary data indicate that the risk of infection is limited if ventilation is set at "high". Further detailed studies should validate this and for other aircraft types.

Emergency Management for Employees Deployed to Foreign Countries

Küpper T.¹, Camerer K.², Konner M.³

1. Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany

2. Centre for Occupational & Travel Medicine Medicine, Schwäbisch-Hall/Germany

3. Centre for Occupational & Travel Medicine, Bergisch-Gladbach/Germany

Aim of the study: Medical and other emergencies (e.g. riots) will definitively happen when employees are deployed to foreign countries. The project should optimize the management such emergencies and the communication with and information of the family at home.

Material and Methods: Specific tasks were defined to handle any problem which may occur. For each task persons were named so that service is available 7/365. The system was validated by real cases in 2019/2020.

Structure and Responsibilities: Three positions were defined, all of them working under direct supervision of the CEO to whom they are reporting: PIC 1 is the only person who communicates with any person or institution on scene. For them there is the advantage of having just one address / phone number / email for communication. PIC 2 cares for the family at home. Because this often includes more or less complicate medical information and a strange situation for the family this should be the company physician who should have routine in difficult conversation with families. PIC 3 should be a public relations professional who is not allowed to communicate anything to the public or any other institution unless PIC 2 has informed the family.

Results and Conclusion: Several real cases in 2019/2020 proved that the system is highly effective. In all cases (N=6) the complete team was fully active in less than 30 minutes independent from the daytime when the emergency call came in.

Automated Reminder in Order to Improve the Vaccination Status of Employees for International Business

Küpper T.¹, Camerer K.², Konner M.³

1. Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany

2. Centre for Occupational & Travel Medicine Medicine, Schwäbisch-Hall/Germany

3. Centre for Occupational & Travel Medicine, Bergisch-Gladbach/Germany

Aim of the study: The compliance of the general population and of employees concerning vaccinations is limited, mainly not for principal reasons but because vaccinations have a low priority in daily routine business. Regular automated reminder may improve this significantly.

Material and Methods: A database was created which includes the vaccination status of the employees of an international engineering company (N=1600). Additional information about individual risks (e.g. allergies) are given. To indicate who did the last changes of data is a „must“ and the date of such changes is stored automatically. A specific data retrieval enables the system to send individual emails („Please contact the

company physician for vaccination“) once a month to those employees, whose vaccination should be boosted or which is incomplete. Additional listings facilitate routine work in the occupational practice.

Results: The system is well accepted by the employees who welcome this service. Compliance was improved significantly: While about 30% of employees were not completely vaccinated for the respective destination of their international business before this has decreased to less than 4% now.

Conclusions: Automated reminder systems enable occupational/travel medicine to care adequately for more than 96% of persons included. The group of the remaining ones mainly consists of anti-vaccinationists.

Stress profile and individual workload monitoring in general aviation pilots – an experiment's setting

Machado P.¹, Dahmann P.², Keimer J.², Saretzki C.¹, Stübing F.², Küpper T.¹

1. Institute of Occupational & Social medicine, RWTH Aachen Technical University, Aachen/Germany

2. Faculty of Aerospace Engineering, Aachen University of Applied Sciences, Aachen/Germany

Introduction: In general aviation, pilot errors cause by far the largest number of all aviation accidents and these are four times more frequent than in civil aviation. Most of these can be traced back to faulty perception and decision-making, related to pilot's workload during flight. Yet, which factors influence the workload of pilots in general aviation remains largely unclear. Training, routine and regulations differ from those in military and commercial aviation. Therefore, very little data is available regarding general aviation pilot's workload in everyday flight operations.

Aim of the study: The objective of the study is to help fill this gap and to contribute to understanding and quantifying 1) how individual workload of general aviation pilots changes during flight, 2) how rising difficulty of maneuvers effects performance and stress levels and 3) to validate flight simulators in relation to on board flying a Stemme S10 VT.

Material and Methods: Pilots undergo a range of stressors that may affect their performance during all phases of flight. Using a psychological and physiological approach, psychological questionnaires are to be filled out before and after flight, while physiological stress indexes (e.g. heart rate, heart rate variability, skin conductance, breathing frequency) and salivary cortisol levels are measured during operations themselves. In a second step, simulator data will be compared to onboard flight in a Stemme S10 VT.

Conclusions: As a result, it will be possible to improve pilot training, validate flight simulators for both, training and research, guide flight regulations, and ultimately, enhance safety.

Introducing the FGMapp in Liberia

Nordmann K.¹; Pérez G.M.²

1. Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany

2. African Women's Research Observatory, Barcelona/Spain

Introduction: Despite the high prevalence of female genital mutilation (FGM) in Liberia, education about FGM is not part of the midwifery curriculum. Therefore, an integrated obstetric and psychosocial care workshop (IOPCW) including an mHealth component in form of a smartphone application based on the WHO guidelines on the care for women with FGM (FGMapp) was designed. This study aims at exploring the potential of introducing the FGMapp in Liberia to improve the knowledge, skills and capacities of Liberian healthcare providers.

Material and Methods: In February 2019 three IOPCWs were carried out in Liberia. Using a feminist interpretation of constructivist grounded theory, the participant observation reports of the IOPCWs were analysed to gain insights about the feasibility and acceptability of the FGMapp, its usability and utility.

Results: Even though technological barriers to mHealth uptake exist, the results of this study describe that the implementation of the FGMapp in Liberia is feasible and acceptable. The current usability of the FGMapp is limited and continued access to the FGMapp might prove to be difficult. The trainees expressed the need for further content to enhance the utility of the FGMapp.

Conclusion: The potential for successful implementation of the FGMapp in the local context was shown. The FGMapp, if refined to match the needs of Liberian healthcare workers, may improve the quality of care received by girls and women who have undergone FGM and may accelerate the abandonment of FGM in Liberia.

Falls during mountain hiking – epidemiological data from the Austrian Alps

Pocecco Elena^{1,2}, Faulhaber Martin¹

1. Department of Sport Science, University Innsbruck, Austria
2. Pedagogical University Tyrol, Austria

Introduction: Mountain hiking is the most popular recreational mountain-sport activity in the European Alps during the summer season. It can provide health-related benefits [1,2] but is also associated with a risk of injuries or even fatalities caused by falls in about 50% of the cases [3]. Therefore, circumstances and risk factors of falls during mountain hiking are analyzed in the present study as crucial to develop evidence-based preventive measures and therefore improve safety.

Methods: Data based on routine documentations of the Austrian Alpine Police and a survey in Tyrol (Austria) were analysed.

Results: The absolute number of fatalities remained stable between 2006 and 2014, whereas the number of non-fatal accidents increased by about 5% per year resulting in a decreasing mortality index. Female mountain hikers were at higher risk for non-fatal falls (OR 1.84) and at lower risk for fatalities (OR 0.58) compared to males [4]. About 75% of the falls occurred during the descent [4] and about 70% of the victims were affected by a defective vision [5]. Falls were a consequence of slipping in nearly 60% of cases [6]; however, slipping on snow or ice seems to be relatively rare (6%) [4].

Conclusions: Although mountain hiking became safer with respect to fatal fall-related accidents, hikers should pay attention to enough regeneration before and regular breaks during descending. Additionally, a check of visual aids should be recommended. Finally, falls during mountain hiking seem to be multifactorial, i.e. they often occur when several factors are present at the same time.

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Chikungunya seroprevalence in two South Pacific Island States – the Cook Islands and Vanuatu

Saretzki C.¹, Dobler G.², Iroc E.³, Mayc Y.³, Touc D.³, Lockingtonc E.³, Alad M.⁴, Heussen N.⁵, Küpper T.¹

1. Institute of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany
2. Bundeswehr Institute of Microbiology, Munich/Germany
3. Cook Islands Ministry of Health
4. Vanuatu Ministry of Health
5. Institute of Medical Statistics, RWTH Aachen Technical University, Aachen/Germany

Introduction: Due to its rapid dissemination to all inhabited continents, initiating large-scale outbreaks with severe human infections and economic loss, Chikungunya virus (CHIKV) can be regarded as one of the most important arboviruses worldwide. Despite its significance, the real impact of CHIKV often remains underestimated. The South Pacific Region was affected by several CHIKV-outbreaks during 2011-2015 but is still underrepresented in arboviral research.

Material and Methods: To improve the understanding of the dimensions of circulating CHIKV, a first seroprevalence survey was conducted in local communities of two South Pacific island countries, the Cook Islands and Vanuatu. In total, 465 patient sera were tested for anti-CHIKV specific antibodies.

Results: A total of 30% (Cook Islands; 4,500 residents) and 8.6% (Vanuatu; 22,660 residents) were calculated to have been affected by CHIKV with major variations in national and international immunity levels, corresponding to a case-detection-rate of 17.4% during the Cook Islands epidemic. Seroprevalence throughout all age groups was relatively constant. Five potential outbreak-protective factors were identified: absence of local species of the genus *Aedes*; presence of *Ae. albopictus* (in absence of ECSA E1-A226V-mutation CHIKV), low local population densities and travel activity and moderate tourism.

Conclusions: Results support preventive and rapid response measures in affected areas.

Pre-existing conditions of trekkers in the Solu-Khumbu region, Nepal

Schmitz S.¹, Apel C.², Bertsch D.³, Cerfontaine C.¹, v.d. Giet S.¹, v.d. Giet M.¹, Grass M.¹, Haunolder M.¹, Hundt N.¹, Kühn C.¹, Risse J.¹, Timmermann L.¹, Wernitz K.², Küpper T.^{1,4}

1. Inst. of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany
2. Helmholtz-Institute for Biomedical Engineering at RWTH Aachen Technical University, Aachen/Germany
3. Dept. of Cardiology, Catholic Hospital Marienhof, Koblenz-Montabaur/Germany
4. Union Internationale des Associations d'Alpinisme (UIAA MedCom), Bern/Switzerland

Introduction: Trekking is becoming more and more popular and the collective is significantly older than e.g. in sport climbing. It can be assumed that some trekkers visit high altitude although they suffer from pre-existing conditions. However, data are scarce which conditions and whether problems en route occur.

Material and Methods: The participants (N=350) answered a questionnaire, covering demographic data, the preparation and performance during the trek, pre-existing conditions and problems caused by such conditions en route. Physical examination, blood pressure, heart rate, body mass index, oxygen saturation, urine (Combur 9) and cholesterol tests were performed. All age groups from 18+ years were included, cardiocirculatory diseases were excluded because these were in focus of a parallel study.

Results: 60.5% of the participating trekkers were male and 35% female, the mean age was 42.7 years (17–76). Pre-existing diseases covered all medical fields with a maximum in the group of orthopaedic and traumatic diagnoses. Many participants had no or minimal knowledge about altitude, its risks (61% showed signs of acute mountain sickness) and physical workload during the trek.

Conclusions: Trekking can generally be recommended but most trekkers need specific advice to travel safely. This includes individual recommendations about the pre-existing – most often orthopaedic – disease and about altitude / acclimatization.

Feasibility of a new pulley repair for multiple pulley ruptures: a cadaver study

Schöffl V., Meisel J., Lutter C., Schöffl I.

Dept. of Orthopaedic and Trauma Surgery, University of Erlangen-Nuremberg, Germany

Introduction: The number of pulley injuries, and complex pulley ruptures in particular, has grown significantly in sports climbing. The feasibility of a new pulley reconstruction in which the tendon graft is pulled through a tunnel in the proximal phalanx was evaluated using a cadaver model, with particular attention paid to the weakening of the bone structure by the drill hole.

Material and Methods: 9 fingers from 6 cadaver hands presenting intact pulley systems were compared to 9 fingers from 6 cadaver hands with missing A2 to A4 pulleys, but which featured a repair using the new surgical technique. Each finger was then fixed to an isokinetic loading device which loaded the finger until repair failure or a fracture (first event) occurred. The forces in the flexor tendons were recorded for each finger.

Results: Comparing the forces recorded at the moment of the first event, the forces in the control group were significantly higher (292.4 N) for FDP than in the group with the operated fingers (212.4 N). Although the forces recorded for FDS at the moment of failure were also higher in the control group, the difference did not reach significance (216.3 N vs. 158.2 N). The most common event in the operated fingers was a graft failure. A fracture of the bone due to the drill hole was never observed.

Conclusions: The new pulley reconstruction could represent an alternative to existing reconstructive techniques. The cause for the higher forces recorded in the control group could be attributed to sutures used in the operated fingers. The new pulley reconstruction method may enable reduced extensor tendon irritation as it avoids contact with the extensor hood, and will hopefully prohibit cortical bone loss, a serious side effect in the “one and one half loop” technique.

Diagnosis of A3 pulley injury using ultrasound

Schöffl V., Deeg J., Lutter C., Bayer T., Schöffl I.

Dept. of Orthopaedic and Trauma Surgery, University of Erlangen-Nuremberg, Germany

Introduction: The pulley rupture is the most common injury in sport climbing. The common approach for diagnosis is to perform a stress examination during forced finger flexion and measuring the distance between tendon and bone (TB distance) at the site of the pulley of interest. However, the threshold for

distinguishing singular from complex pulley ruptures are not consistent in the literature. In order to address the challenge of diagnosing A3 pulley ruptures, a novel indirect approach via investigation of the volar plate was proposed.

Materials and Methods: Eighteen fingers from nine different cadavers were examined using high resolution, dynamic ultrasound before and after inflicting different combinations of singular and multiple pulley ruptures in a standardized fashion. Special attention was paid to the behaviour of the volar plate (VP) with respect to the proximal interphalangeal joint (PIP) and the flexor tendons before and after pulley rupture.

Results: Injuries to the A2 and A4 pulleys were diagnosed via ultrasound with sensitivities of 90% and 94%, and specificities of 100% and 97% respectively. A direct visualization of the A3 pulley was achieved in 61% of the fingers. The distance between tendon and VP became significantly more pronounced after A3 pulley rupture. For distances, greater than 0.9 mm between VP and tendon, a sensitivity of 76% and a specificity of 94% were achieved for determining A3 pulley ruptures. Overall, a cut-off of 2 mm TB distance over the A2 pulley corresponded to diagnostic sensitivity and specificity measures of 94% and 100% respectively for A2 pulley ruptures, and a cut-off of 2 mm TB distance measured over the A4 pulley corresponded sensitivity and specificity measures of 90% and 97% respectively for A4 pulley ruptures.

Conclusions: This study represented the first ultrasound investigation of the efficacy of measuring multiple VP parameters for A3 pulley rupture diagnosis in both single and complex pulley rupture scenarios. The parameter determined to be most promising for accurate A3 pulley rupture diagnosis is the distance measure between VP and tendon, with a measure of greater than 0.9 mm corresponding to rupture of the A3 pulley.

Overuse syndromes and injuries of alpine crossing with the mountainbike

Schreiner H.G.¹, Küpper T.^{2,3}

1. Dept. of Paediatrics, Ostalbklinikum Aalen, Kliniken Ostalb, Aalen/Germany

2. Institute of Occupational & Social Medicine, RWTH Aachen Technical University, Aachen/Germany

3. Medical Commission of the Union Internationale des Associations d'Alpinisme (UIAA MedCom)

Introduction: Alpine crossing (AlpX) with the mountainbike (MTB) has generated a new and rapidly grown mountainbike sport discipline. AlpX includes long distances with a lot of meters to be climbed within a few days. The first documented AlpX started in 1989. In the last years nearly 160.000 people were crossing the Alps with the MTB every year.

Material and Methods: The purpose of the study, based on a complex questionnaire, was to summarize the typical overuse syndromes and injuries caused by MTB AlpX. MTB hours were quantified and overuse syndromes and injuries rated according to the NACA score. To enable comparison to other sports, the injury risk was calculated per 1000 hours of participation.

Results: 120 mountain bikers were analyzed, 18 women and 102 men, the average age was 42.3 years. 76.5% were using a full suspension bike, 94.2% had disc brakes, 77.5% were using click pedals. 97.3% of the bikers wore a helmet.

Overuse syndromes were seen in 12.5% of the study group (overall 19 overuse syndromes), with most problems located at the knee. 19.2% of the sportsmen indicated 39 injuries (47.47% hematomas and contusions, 33.3% injuries by skin lesions and 10.5% fractures. The most injured region was the upper extremities with 31%. Injuries were mostly due to individual faults and 84.6% of the accidents were classified as avoidable. The total of diagnoses resulted in 3.02 overuse problems per 1000 hours, nearly all of them minor ones (NACA 1-3). Injuries showed a risk of 6.19/1000 hours, also the majority with minor consequences (NACA 1-3).

Conclusions: Taking into account that most injuries were minor ones it can clearly be stated that MTB AlpX is a low risk sport. More breaks, good hydration status and being well trained (for example including technical training), may help to reduce the injury risk even further.

Are commercially recommend profiles for preacclimatisation too conservative?

Tannheimer M.

Sektion Sport – und Rehabilitationsmedizin, Universität Ulm, Germany

Introduction: Normobaric hypoxic training (NHT) for pre-acclimatization at home has found its way into commercial expedition mountaineering. Portable NH-generators produce a normobaric hypoxic gas mixture that can be inhaled using breathing masks at rest or during exercise or it can be pumped into lightweight tents for sleeping. These devices can be rented from commercial companies.

Material and Methods: Prior to an expedition to Manaslu (8163 m) we used NHT for preacclimatization over a period for 10 days. Our regimen involved a greater increase in sleeping altitude (10 nights to reach 5400 m) than recommended by the rental company (30 nights to reach 3900 m).

Results: No incidents occurred during NHT. Our regimen induced sufficient acclimatization to Manaslu Base Camp (4900 m), as evidenced by the fact that none of the expedition members suffered from AMS although we reached base camp

rapidly by helicopter flight from Kathmandu to 3500 m and a one-day walk the next day. Eight days after leaving Kathmandu we reached camp III at 6850 m.

Conclusions: At natural altitudes above 2500 m an increase of sleeping altitude should not exceed 300-500 m per day. Below 2500 m, there are no restrictions. It is therefore unclear why the company recommends such a slow increase in sleeping altitude. In our opinion, it is not necessary for healthy persons to start with a sleeping altitude below 2500 m. In contrast to natural altitudes exposure, NH can be instantly stopped if symptoms occur. Therefore it seems safe to expose healthy persons to pronounced hypoxic conditions.