Change in pain and functional parameters in back patients with or without radiculopathy.

Research legislation:	Ordinance on human research with the exception of Clinical trials (HRO) [1].
Type of Research Project:	Research project involving human subjects
Risk Categorisation:	Risk Category A Acc. to ordinance HRO Art.7
Project Leader:	PD Dr. med. Christian Zweifel Department of Surgery Neurosurgery Loëstrasse 170 CH-7000 Chur Phone: 081 256 62 33 Email: christian.zweifel@ksgr.ch

Originally in German, translated into English

To ensure readability, only the male version is chosen throughout the document as a substitute for men and women.

PROTOCOL SIGNATURE FORM

Study Title	Veränderung der Schmerz- und Funktionsparameter bei Rückenpatienten mit oder ohne Radikulopathie.

The project leader has approved the protocol version ***[02 (10.08.2018)]*** and confirms hereby to conduct the project according to the protocol, the Swiss legal requirements [1, 2], current version of the World Medical Association Declaration of Helsinki [3] and the principles of Good Clinical Practice.

Project leader:

Kantonsspital Graubünden, Chur, Departement für Chirurgie, Chefarzt der Neurochirurgie, Loëstrasse 170, 7000 Chur

Name: PD Dr. med. Christian Zweifel

Date: 27.8.18 Signature:

Sponsor:

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Name: Dr. Ron Clijsen

Date: 27.8.18 Signature:

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GLOSSARY OF ABBREVATIONS

BASEC	*Business Administration System for Ethical Committees*
CRF	*Case report form*
FOPH	*Federal Office of Public Health*
HRA	*Humane Research Act*
HRO	*Ordinance on Human*

1 BACKGROUND AND PROJECT RATIONALE

The spectrum of symptoms from which back patients suffer is wide-ranging. Symptoms can be constant or intermittent, are partly movement- and exertion-dependent, and include pain, sensory disturbances, mobility restrictions, and loss of strength (Huang and Sengupta 2014). Based on the duration of the symptoms, back pain is classified as chronic, sub-acute or acute. Furthermore, a subdivision can be divided into specific back complaints, with a recognizable anatomical or physiological cause, or non-specific back complaints, with no recognizable anatomical or physiological cause (Eckardt 2012, Ehrlich and Khaltaev 1999). Possible specific back problems are a herniated disc or narrowing of the spinal canal. In this case, one or more spinal nerves can be threatened/pinched, causing the patient to suffer from radiating symptoms in the supply area of the affected nerve. These radiculopathy symptoms vary in severity and duration and can in turn be dependent on movement and exertion. The longer and more intensively the spinal nerve is compressed, the more pronounced the symptoms manifest themselves and the longer it takes for the regeneration of the nerve tissue and the associated reduction of symptoms. The sensory disturbances in the supply area can develop to numbness, the reduction in strength to complete paralysis of the corresponding characteristic muscles.

The symptoms of pain, sensory disturbances and loss of strength limit the patient's ADL functions and ability to work (Hartvigsen et al. 2017). Therefore, rapid recovery and restoration of function is also important from a socio-economic point of view. The method of choice for non-acutely threatening findings is physiotherapeutic treatment. Physiotherapy is prescribed by doctors in Switzerland. The medical clinical diagnosis and findings include an anamnesis, imaging procedures (Bertilson et al. 2010), a functional examination of the sensory system (sensitivity test) (Tschugg et al. 2017, Iversen et al. 2013), motor skills (force measurement) (Rainville et al. 2003) and nerve mobility (Tawa, Rhoda and Diener 2017). If necessary, the clinical diagnosis of nerve root compression is confirmed or excluded with imaging techniques. In the case of acutely threatening symptoms, such as cauda equina syndrome, surgical decompression of the affected nerve is often carried out, followed by physiotherapeutic follow-up treatment.

For the rehabilitation process, therapy planning and protection vis-à-vis health insurers, proof of efficient and goal-oriented physiotherapeutic therapy through appropriate assessments is indispensable. Although physiotherapeutic (follow-up) treatment for back patients is successful, some of the assessments and treatment methods are insufficiently validated and standardised.

The aim of this prospective observational study is to objectify and validate the pain and functional parameters motor and sensory function. In addition, we would like to record these over time in order to evaluate possible connections with physical impairment and physiotherapeutic objectives.

From the point of view of evidence-based practice, the inventory of the relationships between pain and objective functional parameters is intended to substantiate and optimize physiotherapeutic (after) treatment.

2 PROJECT OBJECTIVES AND DESIGN

2.1 Hypothesis and primary objective

The following working and null hypotheses are to be statistically proven or discarded.

Pain Drawing (VAS)

H0	There is no correlation between pain and physical impairment and health-related quality of life.
H1	There is a correlation between pain and physical impairment and health-related quality of life.
H0	There is no correlation between pain and activity diary.
H1	There is a correlation between pain and activity diary.
H0	There is no correlation between pain and strength and muscle fiber alignment.
H1	There is a correlation between pain and strength and muscle fiber alignment.
H0	There is no correlation between pain and trunk mobility and trunk fluctuations.
H1	There is a correlation between pain and trunk mobility and trunk fluctuations.
H0	There is no correlation between pain and sensory activity.
H1	There is a correlation between pain and sensory activity.

Physical impairment, health-related quality of life (ODQ, SF-36)

H0	There is no correlation between physical impairment, health-related quality of life and activity diary.
H1	There is a correlation between physical impairment, health-related quality of life and activity diary.
H0	There is no correlation between physical impairment, health-related quality of life and strength.
H1	There is a correlation between physical impairment, health-related quality of life and strength.
H0	There is no correlation between physical impairment, health-related quality of life and trunk mobility and trunk fluctuations.
H1	There is a correlation between physical impairment, health-related quality of life and trunk mobility and trunk fluctuations.
H0	There is no correlation between physical impairment, health-related quality of life and sensory perception.
H1	There is a correlation between physical impairment, health-related quality of life and sensory perception.
H0	There is no correlation between physical impairment and thickness of the subcutaneous fat layer and muscle fiber alignment.
H1	There is a correlation between physical impairment and thickness of the subcutaneous fat layer and muscle fiber alignment.

Strength (isometric force measurement of the affected characteristic muscles)

H0	There is no correlation between isometric force and trunk mobility and trunk fluctuations.
H1	There is a correlation between isometric force and trunk mobility and trunk fluctuations.
H0	There is no correlation between isometric force and sensing.
H1	There is a correlation between isometric force and sensing.
H0	There is no correlation between isometric force and thickness of the subcutaneous fat layer and muscle fiber alignment.
H1	There is a correlation between isometric force and thickness of the subcutaneous fat layer and muscle fiber alignment.
H0	There is no correlation between isometric strength and physiotherapeutic objective.
H1	There is a correlation between isometric strength and physiotherapeutic objectives.
H0	There is no correlation between isometric strength and physical impairment and health-related quality of life.
H1	There is a correlation between isometric strength and physical impairment and health-related quality of life.

Trunk mobility and trunk fluctuations

H0	There is no correlation between trunk mobility and trunk fluctuations and sensor technology.

H1	There is a correlation between trunk mobility and trunk fluctuations and sensor technology.
H0	There is no correlation between trunk mobility and trunk fluctuations and physiotherapeutic objectives.
H1	There is a correlation between trunk mobility and trunk fluctuations and physiotherapeutic objectives.
H0	There is no correlation between trunk mobility and trunk fluctuations and thickness of the subcutaneous fat layer and muscle fiber alignment.
H1	There is a correlation between trunk mobility and trunk fluctuations and thickness of the subcutaneous fat layer and muscle fiber alignment.

2.2 Primary and secondary endpoints

The primary objective of this observational study is to objectify the subjective parameters indicated by the patient (pain, physical impairment, health-related quality of life, activity diary) and the objective parameters measured by the investigator (strength, trunk mobility and trunk fluctuations, sensory, neurodynamics, thickness of the subcutaneous fat layer, muscle fiber alignment and physiotherapeutic objectives).
The secondary objective includes the evaluation of possible relationships between the subjective and objective parameters.

Subjective parameters and their objectification:

- **health-related quality of life**
  The health-related quality of life prevailing at the time of measurement is assessed using the German version of the SF-36. The patient fills out the questionnaire independently during the measurement appointment, without being influenced. The examiner adds up the total score achieved and transfers the value to the patient's data sheet.

  Objectification of health-related quality of life:
  SF-36 Questionnaire, German Version

- **Physical impairment**
  The physical impairment prevalent at the time of measurement is assessed using the German version of the Oswestry Disability Questionnaire (ODQ). The patient fills out the questionnaire independently during the measurement appointment, without being influenced. The examiner adds up the total score achieved and transfers the value to the patient's data sheet.

  Objectification of physical impairment:
  Oswestry Disability Questionnaire, German version

- **Pain**
  The pain radiation and the intensity of pain are subjectively assessed by the patient. For this purpose, he is given a sheet with a body chart (pain drawing). With 3 different colors (red = pain, yellow = paresthesia, green = numbness), the patient draws the current sensations at this measurement time. In addition, the patient is surveyed using the visual analogue scale (VAS 0 (no complaints) – 10 (maximum complaints)) to record the intensity of the complaints.

  Objectification of radiation area:
  The pain drawings are scanned and evaluated with the MATLAB software (www.ch.mathworks.com). Here, the radiation area is quantified as a percentage of the total body surface.

  Objectification intensity:

VAS - Scale

- **Activity diary**
  In order to record the patient's daily activities during the duration of the study, the patient will be asked to document their activities in the activity diary on a daily basis. The activity diary is given to the patient and instructed by the study management.

  Objectification of everyday activities:
  Activity diary

Objective parameters and their objectification:

- **Force**
  The maximum isometric force and the force development of the muscles supplied by the affected spinal nerve are tested in a standardized starting position. For this purpose, a dynamometer held by hand by the tester is used. The patient is asked to press against the examiner's hand as hard and as long as possible. In addition, a superficial electromyography is performed, in which the electrodes are glued to the points provided for this purpose on the skin. To ensure that the test situation remains isometric, the examiner applies exactly as much force as the patient is willing to deploy. The test is carried out 3 times in a row with a 30-second break. The values are transferred to the data sheet. The measurements take place on both sides, starting with the subjectively weaker side.

  Objectification power:
  The hand-held dynamometer (NOD, www.to-nod.com) graphically and numerically records the strength and duration of the isometric power delivery. Superficial electromyography is performed with the PLUX EMG device (www.biosignalsplux.com) and evaluated with the associated software.

- **Trunk mobility and trunk fluctuations**
  Mobility
  The maximum mobility of the spine is measured during forward bending (flexion), leaning backwards (extension) and tilting sideways to the left and right (lateral flexion) using the Sway Star™ system. The inspector makes sure that the pelvis remains fixed.

  Trunk swaying during 30 s - one-leg stand
  In order to record the ability to balance and the corresponding trunk reactions, the patient tries to stand as still as possible on one leg barefoot for 30 seconds. In this case, the patient stands to the side of the treatment table so that he or she can hold himself with his hand. The examiner stands behind the patient during testing. The fluctuations that occur during the balance test are measured using the Sway Star™ system. The measurements take place on both sides, starting with the subjectively weaker side.

  Hull Swaying during 8 m – Walking
  In order to measure the trunk movements during walking, the patient walks at a pace of 8 m. The trunk movements are recorded using the Sway Star™ system.

  Objectification:
  The fluctuations of the hull are recorded and evaluated with the Sway Star™ System (www.b2i.info). The Sway Star™ is a measuring instrument that contains gyroscopes. It is attached to a belt that is placed around the patient's waist. The data is evaluated with the associated Sway Star ™software and transferred to the data sheet.

- **Sensors**

The sensory system of the affected area (segmentally associated dermatome) is tested directly on the skin in the radiation area. The results are transferred to the data sheet. The pain threshold is raised on a Valleix point along the iliac crest. Measurements are always taken at the same measuring points, on the affected side.

Objectification of sensor technology:
The pressure sensation is recorded by means of a monofilament, the 2-point discrimination with the Greulich star, the sense of vibration with the tuning fork (according to Rydel-Seiffer), the muscle reflex with the reflex hammer in a left/right comparison including acceleration measurement (accelerometer MSR165, www.msr.ch) and the pain threshold with the algometer (NOD, www.to-nod.com).

- **Neurodynamics**
  The neurodynamics of the affected spinal nerve are tested using the appropriate pain provocation test. For this purpose, a hydrogoniometer is required, with which the exact number of degrees at which the symptoms are triggered is measured. The number of degrees is transferred to the data sheet. The tests are carried out in a standardised manner. If the spinal nerve L2/L3 is affected, the crossed Lasègue test is performed, and for L4/L5/S1 the Lasègue test.

  Objectification of neurodynamics:
  Hydrogoniometer

- **Subcutaneous fat tissue and muscle fiber alignment**
  The thickness of the subcutaneous fatty tissue is measured on the rectus femoris muscle, 10 cm above the patellar base, and on the medial gastrocnemius muscle at the level of the largest calf circumference, in both legs.

  Objectification Thickness Subcutaneous Fat Tissue and Muscle Fiber Alignment:
  The portable ultrasound device from Telemed (www.pcultrasound.com) is used for this purpose. The images are evaluated with the Osirix (www.osirix-viewer.com) software and the number of millimetres, fat thickness and muscle fibre degree angle are transferred to the data sheet.

2.3 Project design

The study is a prospective observational study. There is no intervention. No influence is exerted on the normal physiotherapeutic and medical treatment of patients. At the Graubünden Cantonal Hospital in Chur, repeated measurements are being carried out. Therefore, a single-center study is available here.

3 PROJECT POPULATION AND STUDY PROCEDURES

3.1 Project population, inclusion and exclusion criteria

Participants will be recruited by PD Dr. med. Christian Zweifel. The study will include people who suffer from back pain, with or without radiculopathy, and who present themselves to the neurosurgery department at the Graubünden Cantonal Hospital in Chur. Included are those patients who speak and write German, who will go to physiotherapy treatment because of their back problems and are willing to record their daily activities and intake of pain medication in a diary at home. Excluded are patients who do not suffer from back pain, with or without radiculopathy, or who do not attend physiotherapy treatment due to their back problems, or who are not willing to keep an activity diary with a log of painkiller intake at home.

The German language must be understood orally and in writing in order to understand the patient information and sign the informed consent form. Patients will be definitively included if they meet the inclusion criteria and have signed the informed consent form for participation in the study.

Inclusion and exclusion criteria are summarized in the table below. All inclusion criteria must be met in order to participate in the study. In the case of the exclusion criteria, one unfulfilled point is sufficient to be excluded.

Overview of inclusion and exclusion criteria

Inclusion Criteria	Exclusion criteria
- Back problems with / without radiculopathy - Understanding of German orally and in writing - Physiotherapeutic treatment for back pain - Willingness to keep an activity diary, including a protocol for taking painkillers	- No back problems with / without radiculopathy - No understanding of German orally or in writing - No physiotherapy treatment due to back pain - No willingness to keep an activity diary and/or log of painkiller intake

3.2 Recruitment, screening and informed consent procedure

After approval of the study protocol by the Cantonal Ethics Committee Zurich, the recruitment of suitable subjects is to begin from October 2018 to December 2020. The data collection will take place continuously from October 2018 until June 2021 (see Chapter 3.3).
When the patient with back problems, with or without radiculopathy, is presented to the neurosurgery department at the Graubünden Cantonal Hospital in Chur, he or she is informed that the study is taking place. Both conservative and surgical patients are included. If the patient wants to participate in the study, he or she will be given the written study information, which he or she should read through at his leisure. If you have any questions, you can contact the director of studies at any time. Once all questions have been clarified and the patient is willing to participate in the study, he or she signs the study information and the declaration of consent. Once the signed study information and signed declaration of consent have been submitted by the study management, the health questionnaire is filled out together with the patient, which checks the inclusion and exclusion criteria. If the patient meets the inclusion criteria, the measurement points are planned by the examiner.

3.3 Study procedures

After oral study information by PD Dr. med. Christian Zweifel, after signing the written study information and declaration of consent and clarifying the inclusion and exclusion criteria (health questionnaire), the measurement points are planned. A total of 6 measurement points are determined. The first 5 appointments take place once a month, followed by a 3-month measurement-free period, after which the last and 6th measurement takes place. In the event of complications or worsening symptoms, the head of the study, who is also the attending physician, is informed immediately.

If a conservatively treated patient needs surgery during the study (e.g. due to a worsening of his symptoms), the preoperative data set will be recorded and a new postoperative data set will be opened, provided that the patient wishes to continue participating and/or is not excluded by the study management. The study includes conservatively treated (physiotherapy) and surgically treated patients equally.

If imaging techniques are used in the context of medical diagnosis, these images are included in the data collection and taken into account as far as possible in the interpretation of the data.

Overview of the procedure for recruiting subjects (by PD Dr. med. Christian Zweifel)

Expiration	Screening	Overhead
- Medical diagnosis / clarification - Oral study information	Medical history, findings, diagnostic imaging	10 min
- Return of the signed study information and declaration of consent	Examination of inclusion and exclusion criteria	10 min
- Filling out the health questionnaire	Examination of inclusion and exclusion criteria	5 min

Planning of measurement dates

During the first measurement, the test person is instructed and given to keep the activity diary with a protocol for taking painkillers.

Overview of the measurement process

Expiration	Data collection	Instrument	Time exposure
- Questionnaire	subjective health-related quality of life	SF-36 Questionnaire	5 min
- Questionnaire	subjective physical impairment	ODQ Questionnaire	5 min
- Pain Evaluation	subjective pain radiation and intensity	VAS Pain Drawings	5 min
- Demography	Height, body weight, body fat percentage	Stadiometer, Tanita – Scale	5 min
- Ultrasound measurement of the rectus femoris and gastrocnemius medialis muscles	Thickness of subcutaneous fatty tissue, alignment of muscle fibers, bilateral	Portable Ultrasound Machine (TeleMed)	10 min
- Trunk mobility	Mobility of the spine in flexion, extension, lateral flexion	Sway Star™	2 min
- Hull swaying	Torso movements during 30 s – one-leg stand, both sides	Sway Star™	2 min
- Hull swaying	Trunk Movement during 8m - Walking	Sway Star™	5 min
- Neurodynamics	Pain provocation test, bilateral	Hydrogoniometer	2 min
- Evaluation of the sensor technology	Sensation of pressure, 2-point discrimination, sense of vibration, muscle reflex, pain threshold bilateral	Monofilament, Greulich Star, Neurological Tuning Fork, Reflex Hammer, Accelerometer, NOD Algometer	10 min
- Force measurement	maximum isometric force, force development, bilateral	NOD – isometric load cell, surface electromyography	5 min

The maximum time required per measurement appointment is one hour. With 6 measurement points, the time required adds up to 6 hours and extends over 8 months.

In addition, the patient keeps an activity diary at home and logs the painkiller intake, which takes about 5 minutes a day.

The treating physiotherapist records the content of all therapy sessions. The protocol to be used for this purpose is explained and instructed to the physiotherapist by the investigators at the beginning of the study. The documentation of physiotherapeutic treatment is one of the duties of a physiotherapist, so there is no additional effort for him. All he has to do is use the protocol template. Furthermore, the treating physiotherapists are asked to continue their usual interventions and treatments regardless of the study participation of their patients.

The following biases could occur:
- Sociodemographic and personal characteristics of the subjects: men/women, age
- Duration of back pain
- Truthful keeping of the activity diary and painkiller intake log
- physiotherapeutic treatment

By the time a patient presents to the neurosurgery department, the back pain has already reached a high degree of severity. The duration and intensity of symptoms vary and should be stratified in evaluation. The measurement times should be strictly adhered to in order to ensure comparability in time between the test subjects.

The study ends in the 8th month after the start of the study after the 6th and last measurement.

3.4 Withdrawal and discontinuation

Participants will be excluded from the study if they do not (or cannot or do not want to) fulfill their obligations that entail participation in the study, or if they wish to voluntarily withdraw from participating in the study. Data that has already been collected is included in the data analysis as far as possible. If a conservatively treated patient needs surgery during the study (e.g. due to a worsening of his symptoms), the preoperative data set will be recorded and a new postoperative data set will be opened, provided that the patient wishes to continue participating and/or is not excluded by the study management.

4 STATISTICS AND METHODOLOGY

4.1. Statistical analysis plan

The required number of subjects was determined a priori with G*Power (version 3.1.9.2; Franz Faul University of Kiel, Germany). The following design specifications were used: statistical test = Correlation Type of Power Analysis 'Computer required sample size – given α, power and effect size'; tails = two; effect size = 0.5; α = 0.05; power = 0.95. The target number of subjects was n = 42 based on these design specifications. The SPSS version 24 software is used for statistical data analysis (IBM, Armonk, NY, USA).

The data are first checked for normal distribution with the 'Shapiro-Wilk test'. The normally distributed data are analysed by means of parameteric test procedures. Non-normally distributed data as well as non-metric data are checked with non-parametric tests. The correlations are recorded using the 'Pearson Correlation tests' and 'Spearman Correlation tests'.

Correlations between the subjective parameters (pain, physical impairment, activity diary), between the objective parameters (strength, balance, sensory, neurodynamics, muscle thickness

and physiotherapeutic objectives), as well as between the subjective and objective parameters are of interest and should be calculated.

The following working (H1) and null hypotheses (H0) are statistically proven or rejected:

Pain Drawing (VAS)

H0	There is no correlation between pain and physical impairment and health-related quality of life.
H1	There is a correlation between pain and physical impairment and health-related quality of life.
H0	There is no correlation between pain and activity diary.
H1	There is a correlation between pain and activity diary.
H0	There is no correlation between pain and strength and muscle fiber alignment.
H1	There is a correlation between pain and strength and muscle fiber alignment.
H0	There is no correlation between pain and trunk mobility and trunk fluctuations.
H1	There is a correlation between pain and trunk mobility and trunk fluctuations.
H0	There is no correlation between pain and sensory activity.
H1	There is a correlation between pain and sensory activity.

Physical impairment (ODQ), health-related quality of life (SF-36)

H0	There is no correlation between physical impairment, health-related quality of life and the activity diary.
H1	There is a correlation between physical impairment, health-related quality of life and the activity diary.
H0	There is no correlation between physical impairment, health-related quality of life and strength.
H1	There is a correlation between physical impairment, health-related quality of life and strength.
H0	There is no correlation between physical impairment, health-related quality of life and trunk mobility and trunk fluctuations.
H1	There is a correlation between physical impairment, health-related quality of life and trunk mobility and trunk fluctuations.
H0	There is no correlation between physical impairment, health-related quality of life and sensory perception.
H1	There is a correlation between physical impairment, health-related quality of life and sensory perception.
H0	There is no correlation between physical impairment, health-related quality of life, and subcutaneous fat layer thickness and muscle fiber alignment.
H1	There is a correlation between physical impairment, health-related quality of life and thickness of the subcutaneous fat layer and muscle fiber alignment.

Force (isometric force measurements)

H0	There is no correlation between isometric force and trunk mobility and trunk fluctuations.
H1	There is a correlation between isometric force and trunk mobility and trunk fluctuations.
H0	There is no correlation between isometric force and sensing.
H1	There is a correlation between isometric force and sensing.
H0	There is no correlation between isometric force and thickness of the subcutaneous fat layer and muscle fiber alignment.
H1	There is a correlation between isometric force and thickness of the subcutaneous fat layer and muscle fiber alignment.
H0	There is no correlation between isometric strength and physiotherapeutic objective.
H1	There is a correlation between isometric strength and physiotherapeutic objectives.

Trunk mobility and trunk fluctuations (SwayStar ™measurements)

H0	There is no correlation between trunk mobility, trunk fluctuations and sensor technology.

H1	There is a correlation between trunk mobility, trunk fluctuations and sensor technology.
H0	There is no correlation between trunk mobility, trunk fluctuations and physiotherapeutic objectives.
H1	There is a correlation between trunk mobility, trunk fluctuations and physiotherapeutic objectives.
H0	There is no correlation between trunk mobility, trunk fluctuations and thickness of the subcutaneous fat layer and muscle fiber alignment.
H1	There is a correlation between trunk mobility, trunk fluctuations and thickness of the subcutaneous fat layer and muscle fiber alignment.

4.2. Handling of missing data

Since statistical values of the individual relationships are determined, the data is also included if a test subject does not participate in all measurement points and/or measurements. Incomplete data from individual assessments (aborted tests) are not included in the final data analysis, but are recorded and stored.

5 REGULATORY ASPECTS AND SAFETY

5.1 Local regulations / Declaration of Helsinki

This research project will be conducted in accordance with the protocol, the Declaration of Helsinki [3], the principles of Good Clinical Practice, the Human Research Act (HRA) and the Human Research Ordinance (HRO) [1] as well as other locally relevant regulations. The Project Leader acknowledges his responsibilities as project leader and the sponsor as sponsor.

5.2 Notification of safety and protective measures (HRO Art. 20)

The project leader and the sponsor are promptly notified (within 24 hours) if immediate safety and protective measures have to be taken during the conduct of the research project. The Ethics Committee will be notified via BASEC of these measures and of the circumstances necessitating them within 7 days.

5.3 Serious events (HRO Art. 21)

If a serious event occurs, the research project will be interrupted, and the Ethics Committee notified on the circumstances via BASEC within 7 days according to HRO Art. 21[1].

5.4 Radiation

In addition to the standard imaging techniques used to make a diagnosis, no additional radioactive methods will be used in the study.

5.5 Amendments

Substantial changes to the project set-up, the protocol and relevant project documents will be submitted to the Ethics Committee for approval according to HRO Art. 18 before implementation. Exceptions are measures that have to be taken immediately in order to protect the participants.

[1] A serious event is defined as any adverse event where it cannot be excluded, that the event is attributable to the sampling of biological material or the collection of health-related personal data, and which:a. requires inpatient treatment not envisaged in the protocol or extends a current hospital stay;
b. results in permanent or significant incapacity or disability; or
c. is life-threatening or results in death.

5.6 End of project

If the project is completed, the ethics committee will be informed within 90 days. After completion of the project, the encrypted data will be stored for another ten years at the Graubünden Cantonal Hospital in Chur, Department of Surgery, Neurosurgery. Only encrypted data will be used for the study and all persons involved will be subject to confidentiality, even after the end of the project.

5.7 Insurance

If damage is suffered as a result of the study project, the liability insurance of the Cantonal Hospital of the Grisons in Chur is liable, in the case of actions by PD Dr. Christian Zweifel, who is an employee of the Cantonal Hospital of the Grisons in Chur. His actions in this study are carried out during his regular working hours and include standard procedures as part of his medical activity. If a patient experiences damage during actions by the examiner, the insurance company of "Thim van der Laan AG", the employer of the examiner, is liable. This applies as long as the damage suffered is not based on disregard or neglect of the requirements. The requirements and the procedure are regulated by law. If damage is suffered, the head of the study (PD Dr. med. Christian Zweifel).

6 FURTHER ASPECTS

6.1 Overall ethical considerations

The additional effort for the participants is a total of six hours. This involves travel expenses or the like, as the measurements take place at the Graubünden Cantonal Hospital in Chur. Therefore, participants will be compensated with CHF 20 per measurement time.
The generalizability of the resulting results is limited and limited to back patients with or without radiculopathies. Participants have the right to information at any time and, if desired, will also be informed about the results and their significance for people with radiculopathy (verbally or in writing). The test subjects are not exposed to any additional risks, all measurement methods used here are used in physiotherapy or as part of the medical examination.

6.2 Risk-Benefit Assessment

Participation is not associated with any benefit and no disadvantage for the test subjects. Thanks to participation in the study, the results can benefit other people suffering from back pain with or without radiculopathy in the future, as possible connections between objective and subjective parameters become recognizable. It is hoped that this will further increase treatment and understanding for back patients. There are no risks for the participants. There is only the possibility that an increase in pain occurs for a short time after the measurements, due to the pain provocation test.

6.3 Rationale for the inclusion of vulnerable participants

No vulnerable people are examined.

7 QUALITY CONTROL AND DATA PROTECTION

7.1 Quality measures

The measurements and surveys are carried out exclusively by trained personnel. The examiners who carry out the measurements and interviews are trained physiotherapists with experience in dealing with back patients. Patient recruitment is carried out by the head of the study, PD Dr. med. Christian Zweifel will take place.

For quality assurance, the Ethics Committee may visit the research sites. Direct access to the source data and all project related files and documents must be granted on such occasions.

7.2 Data recording and source data

Data protection and confidentiality are guaranteed and no personal data is presented or published. The signed study information, informed consent, completed questionnaires, data sheets and all documents containing personal data are stored in a locked cabinet. Only the head of studies has access to the key. The encryption of the identity of the test persons is not digitally recorded. The encrypted data is transferred to Excel and digitized, printed out with the test subject and version number so that no falsification is possible. At the time of evaluation, the data is transferred by the auditors to the SPSS, where the correlations are calculated.

7.3 Confidentiality and coding

Project data will be handled with uttermost discretion and is only accessible to authorized personnel who require the data to fulfil their duties within the scope of the research project. On the CRFs and other project specific documents, participants are only identified by a unique participant number.

7.4 Retention and destruction of study data and biological material

After completion of the project, the data will be stored for another ten years at the Graubünden Cantonal Hospital in Chur. Data protection remains guaranteed throughout the entire period.

8 FUNDING / PUBLICATION / DECLARATION OF INTEREST

There is no conflict of interest in this study. Financing is provided by the sponsor University of Applied Sciences and Arts Southern Switzerland, Landquart (SUPSI). The study is being carried out as part of a research project at the University of Applied Sciences and Arts Southern Switzerland (SUPSI). The goal is to publish several articles from the collected data and their evaluations.

9 REFERENCES

1. Ordinance on Human Research with the Exception of Clinical trials (HRO) http://www.admin.ch/opc/en/classifiedcompilation/20121177/201401010000/810.301.pdf
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