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Spine Examination during COVID-19 Pandemic via Video Consultation

Telemedizinische Wirbelsäulenuntersuchung während der COVID-19-Pandemie

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Key words

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ABSTRACT

Introduction During the current COVID-19 pandemic video consultations are increasingly common in order to minimize the risk of infection for staff and patients. The aim of this study was to evaluate the feasibility of a spine examination via video.

Methods A total of 43 patients were recruited. Each participant underwent a video-based (VB) and a conventional face-to-face (FTF) spine examination. Pain intensity, active range of motion, inspection, a neurophysiologic basic exam and provocations tests were evaluated using video-based and face-to-face methods.

Results The intra-rater reliability (IRR) was measured between both examinations. Good to very good IRR values were obtained in inspection (Kappa between 0,752 und 0,944), active range of motion and basic neurophysiological examination (Kappa between 0,659 und 0,969). Only moderate matches were found in specific provocation tests (Kappa between 0,407 und 0,938). A video-based spine examination is a reliable tool for measuring pain intensity, active range of motion and a basic neurophysiologic exam.

Conclusion A basic spine examination during a video consultation is possible. A good agreement of the test results between video-based and face-to-face examination could be found.

ZUSAMMENFASSUNG

Einleitung Während der aktuellen COVID-19-Pandemie sind Videosprechstunden zur Kontaktvermeidung zunehmend verbreitet. Die vorliegende Studie soll die Machbarkeit einer Wirbelsäulenuntersuchung im Rahmen einer Videosprechstunde evaluieren.

Methoden Es wurden 43 Patienten in unserer Klinikambulanz untersucht. Die Patienten wurden zunächst videogestützt und unmittelbar später mit direkten Arzt-Patienten-Kontakt untersucht. Zur Strukturierung der Untersuchungsergebnisse wurde bei allen Untersuchungen ein systematischer Frage- und Untersuchungsbogen verwendet. Gemessen wurde die Intrarater-Reliabilität (IRR) zwischen beiden Untersuchungsdurchgängen.

Ergebnisse Gute bis sehr gute IRR-Werte ergaben sich bei Inspektion (Kappa zwischen 0,752 und 0,944), Bewegungsausmaßen und neurophysiologischer Basisuntersuchung (Kappa zwischen 0,659 und 0,969). Nur moderate Übereinstimmungen konnten bei spezifischen Provokationstests (Kappa zwischen 0,407 und 0,938) gefunden werden.

Schlussfolgerung Eine Basisuntersuchung der Wirbelsäule ist im Rahmen einer Videosprechstunde möglich. Es konnte eine gute Übereinstimmung der Testergebnisse zwischen videogestützter und direkter Arztuntersuchung gefunden werden.

Background and Objective

The back is the commonest location of musculoskeletal pain [1]. According to the most recent Global Burden of Disease report, diseases of the musculoskeletal system contribute most to global invalidity, while low back pain is the most common cause of incapacity for work [2]. The lifetime prevalence of back pain in the German adult population is 85.5 % [3]. Back pain is therefore extremely important medically and economically and often requires outpatient or inpatient treatment.

Because of the COVID-19 pandemic, contact restrictions ("social distancing") and quarantine measures have become the new normal. Patients increasingly avoid visiting doctors in their practices or hospitals for fear of becoming infected [4]. Telemedicine has the potential to enable specialist medical consultation, at the same time minimising the risk of exposure to SARS-CoV2 [5]. There is therefore an increasing focus on telemedicine instruments such as video consultations. Previous studies have already described the general potential of telemedicine [6]. This certainly applies especially in disaster and infection prevention scenarios [7]. With the widespread use of smartphones, tablets, computers and commercial video consultation providers, the necessary technical equipment is available almost everywhere [8]. Previous studies have shown that video consultation can be used successfully for postoperative wound review or to discuss radiological results [9].

Nevertheless, to date there are no recommendations or guidelines regarding video-assisted examination of patients with back pain using telemedicine. The aim of this study is to address the feasibility and practicability of clinical examination of the spine in a video consultation during the ongoing COVID-19 pandemic.

Study Design and Investigation Methods

Patients with spinal complaints were examined once in a video consultation and then during a direct face-to-face medical consultation. For the study, the first video-assisted examination took place in an examination room in a university hospital outpatient clinic without assistance by relatives or medical staff. The examiner was in the next room at the same time.

Directly following the first video-assisted examination, the patient was examined again face-to-face. To limit the study to examining the feasibility and to avoid intra-observer variability, both examinations were performed by the same doctor. Two specialists in orthopaedics and trauma surgery carried out the examinations.

Technical equipment

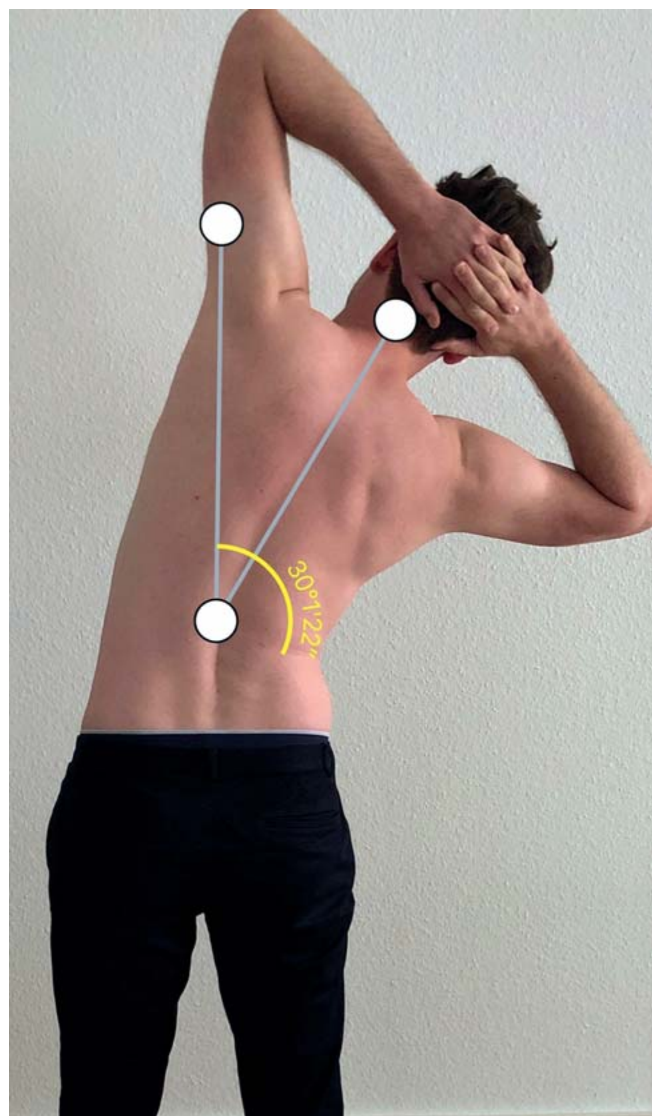
The examiner used the usual standard setup for a video consultation (HP Elitedesk desktop computer, Logitech C270 webcam, Logitech H390 head-set).

The video consultation provider used in the study was arztkonsultation ak GmbH (Schwerin, Germany). We used the "Angle Meter 360" application (developed by Alexey Kozlov) to measure the active range of motion (AROM) (▶ **Fig. 1**). The subjects used a tablet with integrated camera and microphone (Apple, iPad Air 2) for transmission to the examiner in real-time.

Collected data

A systematic question and answer form was used at all examinations to structure the results (▶ **Fig. 2**). This contains multiple-choice questions on inspection, pain location, pain severity, range of motion, provocation tests and a basic neurophysiological examination. In the video consultation the provocation tests were modified so that they could be performed by the patient on his own. The Lasegue, reverse Lasegue, Lhermitte, Adams and intervertebral cervical spine compression tests were performed.

Grading of the power of the key muscle in the basic neurophysiological examination was in only three levels (full power, against gravity and paresis) instead of the usual Janda five-point scale. For a rough assessment of power in the upper limb, the patient was provided with an ordinary plastic bottle (1.5 l PET) filled with water.



▶ **Fig. 1** Measurement of the active range of motion via the "Angle Meter 360" application.

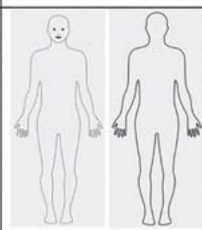
Wirbelsäulenuntersuchungsleitfaden Videosprechstunde

Nachname:	Vorname:	Geburtsdatum:

Inspektion Gangbild						
Gangbild	☐ Flüssig + frei	☐ Nach vorne gebeugtes Gangbild	☐ Nur an UAGs/Rollator mögl.	☐ Unsicheres Gangbild	☐ Nicht möglich	☐ N.B.

Inspektion Rücken							
Inspektion von dorsal (Mehrfachnennungen mögl.)	☐ Schulter- und Beckengeradstand	☐ Schulter- oder Beckenschiefstand oder Taillendreieckasymmetrie	☐ Tannenbaumphänomen		☐ N.B.		
Infektzeichen (Hautrötung, Schwellung)	☐ Ja	☐ Nein	☐ N.B.				
Auffälligkeiten Wunde/Narbe (Mehrfachnennungen mögl.)	☐ Keine Wunde/Narbe	☐ Keine Auffälligkeiten der Wunde/Narbe	☐ Wundsekret klar/serös	☐ Wundsekret trüb/eitrig	☐ Wunddehiszenz	☐ V.a. Fistel	☐ N.B.
Inspektion von lateral	☐ Physiolog. Brustkyphose und Lendenlordose	☐ vermehrte Brustkyphose	☐ vermehrte Lendenlordose	☐ N.B.			
Schmerzlokalisation (Mehrfachnennung mögl.)	☐ HWS	☐ BWS	☐ LWS/ISG	☐ N.B.			

Schmerzlokalisation einzeichnen



Numerical Analogue Scale (NRS) Schmerzen
(0-10, 0= kein Schmerz, 10=stärkster vorstellbarer Schmerz)

Nackenschmerz: _____

Armschmerz: _____

Rückenschmerz: _____

Beinschmerz: _____

a

Funktion HWS					
Aktive In-und Reklination (Abb. a)	_/_/_ ☐ N.B.	Aktive Lateralbeugung (Abb. b)	_/_/_ ☐ N.B.	Aktive Rotation (Abb. c)	_/_/_ ☐ N.B.

Funktion BWS / LWS							
Aktiv nach hinten beugen (Extension) (Abb. d)	_/_/_ ☐ N.B.	Aktive Seitneigung (Abb. f)	_/_/_ ☐ N.B.	Aktive Oberkörperrotation (Abb. g)	_/_/_ ☐ N.B.	Aktiv nach vorne beugen (Abb. h)	_/_/_ ☐ N.B.

Test HWS				
Formen intervertebrale Kompressions-Test (Abb. 1 a +b)	☐ Pos. und Schmerz dermatombezogen	☐ Pos. und Schmerz HWS lokal	☐ neg.	☐ N.B.

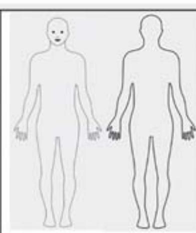
Tests BWS + LWS			
Adams Test	☐ pos. (Rippenwulst/Lendenwulst)	☐ neg.	☐ N.B.
Prüfung von Fersenfallschmerz	☐ pos. (Schmerz im Rücken)	☐ neg.	☐ N.B.
Mod. aktives umgekehrtes Lasegue'sches Zeichen (ohne Untersucher)	☐ pos. (vermehrter Schmerz ventraler OS)	☐ neg.	☐ N.B.
Lhermitte'sches Zeichen (ohne Untersucher)	☐ pos. (vermehrter Schmerz Wirbelsäule und obere oder untere Extr.)	☐ neg.	☐ N.B.
Mod. aktives Lasegue'sches Zeichen (ohne Untersucher)	☐ pos.	☐ neg.	☐ N.B.

b

▶ **Fig. 2** Systematic anamnestic questionaire and clinical findings. **a** Page 1. **b** Page 2.

Neurolog. Untersuchung HWS	
Kopf Nicken und drehen („Kleines Ja und Nein“) C1&C2	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Hals vor- und rückbeugen („Großes Ja“) C1-C4	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Tief- ein und ausatmen („Seufzer“) C3&C4	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Oberarm abspreizen („Bodybuilding“) **mit 1-1.5l Flasche** C5	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Ellenbogengelenk beugen („Kampfgruß) **mit 1-1.5l Flasche** C6	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Ellenbogengelenk strecken und radial abduzieren („Bestechung“) **mit 1-1.5l Flasche** C7	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Finger beugen („Jendassik“) C8	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Finger spreizen und schleißen („Schere“) Th1	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Neurolog. Untersuchung BWS / LWS	
Oberschenkel beugen („Treppensteigen“, „in die Hocke gehen und wieder aufstehen“)	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Knie strecken („Treppensteigen“, „in die Hocke gehen und wieder aufstehen“)	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Fuß dorsal flektieren („Hackenstand“)	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Großzehe dorsal flektieren („Außenkantenstand“)	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.
Fuß plantar flektieren („Zehenstand“)	☐ Volle Kraft ☐ gegen die Schwerkraft mögl. ☐ Lähmung ☐ N.B.

c

Sensibilitätsausfälle (HWS/BWS/LWS)	 ☐ Ja, bitte Lokalisation einzeichnen ☐ Keine Ausfälle ☐ N.B.
Wasserlassen	Frequenz _______ / Tag ☐ Wasserlassen ohne Probleme ☐ nur mit Pressen mögl. ☐ Harnverhalt ☐ N.B.
Stuhlgang **d**	Frequenz _______ / Tag ☐ Stuhlgang ohne Probleme ☐ unwillkürliche Stuhlabgänge/Sphincterstörung ☐ Verstopfung ☐ N.B.

▶ **Fig. 2** Systematic anamnestic questionaire and clinical findings (continued). **c** Page 3. **d** Page 4.

Study population

After giving informed consent, 43 patients were examined in our university hospital outpatient clinic.

The inclusion criteria were:

- Patient age over 18 years
- Referred by the specialist in orthopaedics and trauma surgery with spinal complaints
- Knowledge of German
- No cognitive deficits
- Written consent to take part in the study

Statistical analysis

Statistical analysis was performed with “R” version 4.0.0. Frequency distributions and the Cohen kappa test (in the corrected Brennan-Prediger version) to calculate the intra-rater reliability (IRR). The IRR was interpreted as follows, after Altman: 0 to 0.20

▸ **Table 1** Agreement of the test results.

Category	Examination	Kappa	CI	SE	p
Pain location	NRS pain	0.974	(0.923; 1.000)	0.026	< 0.0001
	Pain location	1.000	(1.000; 1.000)	0.000	< 0.0001
Inspection	Dorsal inspection	0.752	(0.592; 0.912)	0.079	< 0.0001
	Gait	0.944	(0.866; 1.000)	0.039	< 0.0001
	Signs of infection	0.930	(0.833; 1.000)	0.048	< 0.0001
	Lateral inspection	0.814	(0.672; 0.956)	0.070	< 0.0001
	Wound inspection	0.973	(0.919; 1.000)	0.027	< 0.0001
Neurophysiological examination	C I and C II	0.938	(0.852; 1.000)	0.043	< 0.0001
	C I–C IV	0.969	(0.907; 1.000)	0.031	< 0.0001
	C III and C IV	0.969	(0.907; 1.000)	0.031	< 0.0001
	C V	0.876	(0.757; 0.995)	0.059	< 0.0001
	C VI	0.907	(0.802; 1.000)	0.052	< 0.0001
	C VII	0.907	(0.802; 1.000)	0.052	< 0.0001
	C VIII	0.935	(0.844; 1.000)	0.045	< 0.0001
	Th I	0.907	(0.802; 1.000)	0.052	< 0.0001
	Hip flexion	0.659	(0.48; 0.838)	0.089	< 0.0001
	Knee extension	0.721	(0.554; 0.888)	0.083	< 0.0001
	Dorsiflexion	0.814	(0.672; 0.956)	0.070	< 0.0001
	Great toe extension	0.721	(0.554; 0.888)	0.083	< 0.0001
	Plantarflexion	0.721	(0.554; 0.888)	0.083	< 0.0001
	Sensory deficits	1.000	(1.000; 1.000)	0.000	< 0.0001
	Urination frequency	1.000	(1.000; 1.000)	0.000	< 0.0001
	Defecation quality	1.000	(1.000; 1.000)	0.000	< 0.0001
Provocation tests	Adams test	0.407	(0.181; 0.633)	0.112	0.001
	Pain on heel strike	0.860	(0.726; 0.995)	0.066	< 0,0001
	Cervical spine neuroforaminal compression test	0.938	(0.852; 1.000)	0.043	< 0.0001
	Lasègue	0.512	(0.295; 0.728)	0.107	< 0.0001
	Reverse Lasègue	0.407	(0.181; 0.633)	0.112	0.001
	Lhermitte	0.686	(0.498; 0.874)	0.093	< 0.0001

NRS: Numerical Rating Scale; CI: Confidence Interval; SE: Standard Error

poor; 0.20–0.40 low; 0.40–0.60 moderate; 0.60–0.80 good; 0.80–1.00 very good [10].

Informed consent and ethics committee approval

Verbal and written consent was obtained from all study participants. The mental and physical integrity of the participants was respected and protected in accordance with the Declaration of Helsinki [11]. The study was examined and approved by the university's ethic committee (ethics application no. 163/20).

Results

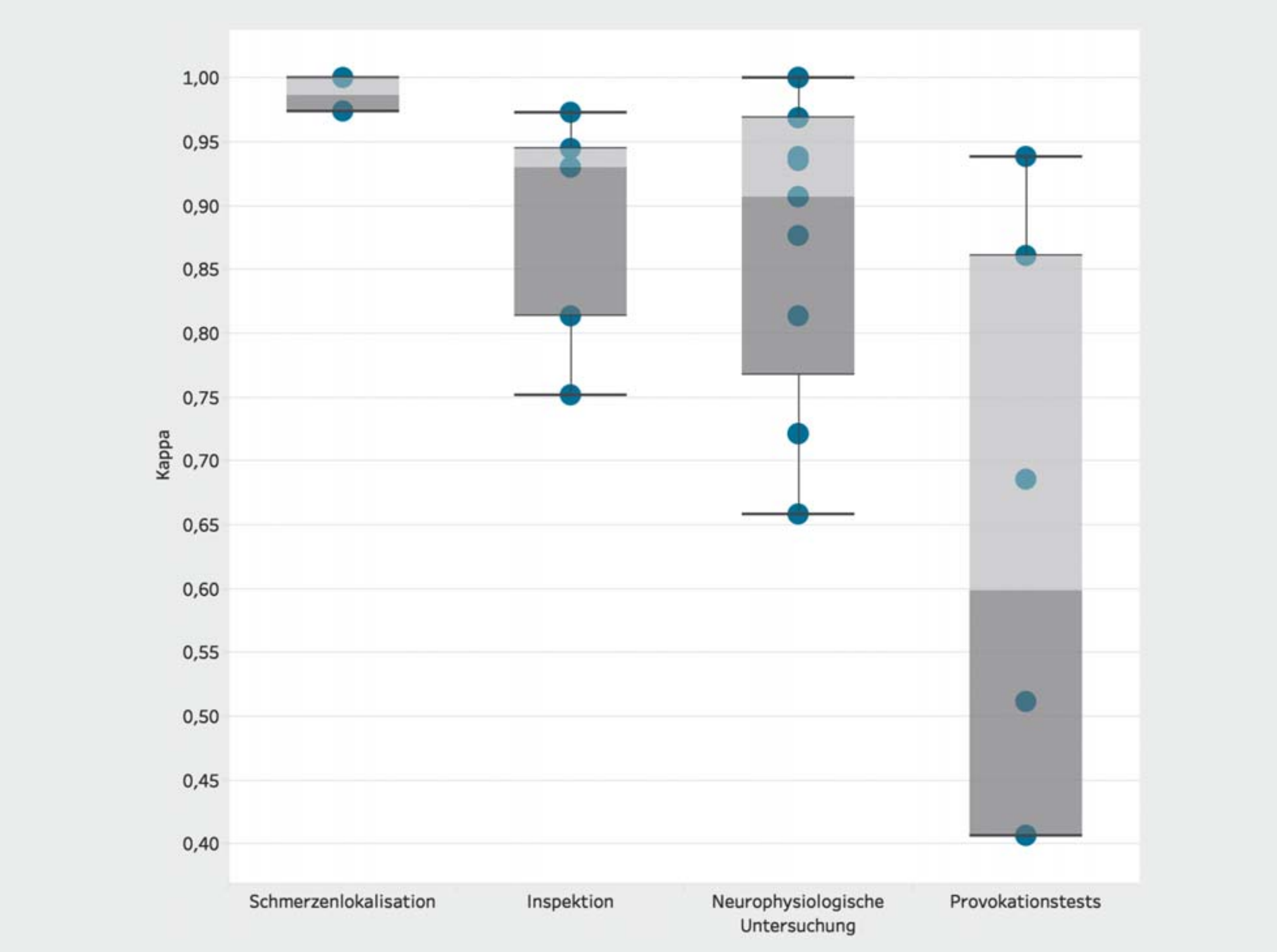
43 patients in total (24 women and 19 men) were recruited for the study. The average age was about 60 years and the average body mass index was 28.6 ± 6.2 kg/m^2 (18.6–38.5).

Pain intensity and location

The average pain intensity measured by numerical rating scale (NRS) [12] was 4.7 (SD ± 2.3) in both examination with high IRR (kappa = 0.974). The majority of the patients suffered from pain of the lumbar spine (76.7 %). There was complete agreement regarding pain location between the results obtained by video consultation and those in the face-to-face examination (kappa = 1.00).

Inspection

There was very high agreement in the examination results between the video-based (VB) and direct face-to-face examination (FTF) in gait assessment (kappa = 0.944; CI=(0.866; 1.000); p < 0.0001), wound inspection (kappa = 0.973; CI=(0.919; 1.000); p = 0.000 000 001) and lateral inspection (kappa = 0.814; CI=(0.672; 0.956); p < 0.0001) (▸ **Table 1**). Posterior inspection



▶ **Fig. 3** Match scores between different physical examination.

showed somewhat poorer agreement of the examination results between VB and FTF (kappa = 0.752; CI=(0.592; 0.912); p < 0.0001).

Range of motion

In the measurement of the AROM differences of ± 5° were interpreted as method-related inaccuracies and accepted as equivalent [13]. There was good correlation between the two examinations.

Basic neurophysiological examination

When the results of the basic neurophysiological examination are considered, a distinction should be made between the upper and lower extremity. There was very good agreement overall between VB and FTF in the examination of the upper limb (kappa between 0.876 and 0.969). Examination of the lower limb yielded good agreement levels (kappa between 0.659 and 0.814).

Provocation tests

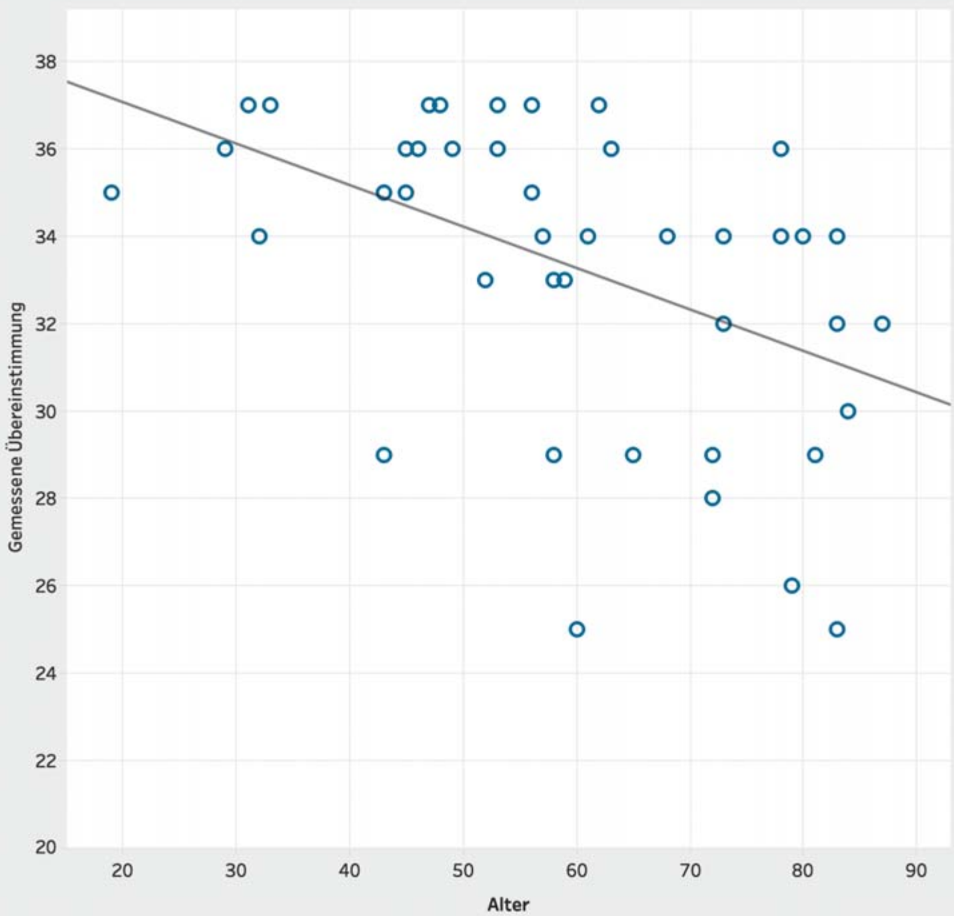
The provocation tests showed very varied but overall poorer agreement between VB and FTF. On the one hand, agreement was only moderate in the Lasègue test, reverse Lasègue test and Adams forward bend test. On the other hand, there was very good agreement for the cervical spine neuroforaminal compression test.

General trends

Agreement between the different dimensions of physical examination diminished in the following order: pain location, inspection, neurophysiological examination and provocation tests (▶ **Fig. 3**). Moreover, an age-dependent decrease in agreement was measured across all dimensions (▶ **Fig. 4**).

Discussion

The rapid introduction and integration of telemedicine into orthopaedic and trauma surgery care is possible today due to the rapid advances in communication technology [14]. The technical re-



▶ **Fig. 4** Age-dependent cross-dimensional agreement values.

quirements for setting up a video-based consultation are easy to meet and present almost everywhere in medical practices and hospitals [15]. Patients are open to telemedicine solutions [16] and are often just as satisfied with a video consultation as with a conventional outpatient treatment [17, 18].

Factors that can make physical examination via video consultation more difficult are low internet bandwidth [19], low camera resolution on the patient's side, poor lighting, excessive complexity of the tests performed [20] and poor videoconferencing etiquette [21]. Since palpation of the patient is not possible, a body diagram can be sent before the video examination in order to narrow down the pain [19]. Physical examination with palpation of, for example, muscle tension, tender points, instability tests or manual therapy tests such as the standing flexion test is likewise not possible.

The patient population with spinal complaints is very varied as regards age, socioeconomic status [22] and technical equipment. Some patients are therefore very suitable for video-based consultation, are comfortable with the technology and value the time efficiency and lack of travel time associated with video consultations [23, 24]. Other patients have great difficulty in following and implementing the doctor's instructions by video. In our study, correct camera positioning by the patient in particular was a critical point in assessing the overall course of the examination. It is probably often difficult to evaluate gait disorders or clinical signs of myelopathy in a video consultation. With the majority of patients, however, it is possible to perform an inspection and examine AROM and power during a video consultation [25]. Examination of muscle power had to be adapted to make it practically possible in a video consultation. Manual testing of muscle function according to Janda [26] with five levels is not possible in a video consultation without an examiner. We therefore simplified the measurement of power into three levels ("full power", "against gravity" and "paresis"). In addition, examination of the key muscles of the lower limb by video was often more difficult to assess than that of the upper limb. The provocation tests were difficult to impossible for a few patients. Elderly patients in particular had problems in our study in carrying out specific tests in the camera's field of view. The mortality rate due to COVID-19 is markedly increased precisely in the group of elderly and multimorbid patients and special infection prevention would be particularly important for this group of patients. Possible examination by video consultation would therefore be a useful addition to the conventional medical consultation especially for elderly patients. Assistance in carrying out a video consultation with elderly patients by relatives, friends or home carers could solve this dilemma but was not investigated in our study.

Limitations

This study has a range of limitations. The spinal examinations by video consultation were performed in a simulated setting in a hospital outpatient clinic. The technical equipment was provided for the patient on site. The intra-rater reliability was measured in two successive examinations. Because of this method, the examiner can still recall the previous examination during the second examination, so examiner bias is possible. The question of whether an examiner who is not familiar with carrying out a video consultation obtains the same results was not addressed. Furthermore, the study was conducted in a relatively small group of patients.

Conclusion

Our study shows the feasibility and limits of video-based spinal examination. Video consultations are a form of technology accepted by patients and readily usable for diagnostic investigation of back pain. Examination with direct face-to-face doctor-patient contact is and remains the gold standard. In the current COVID-19 pandemic, specialist consultation and spinal examination are possible by this means, without the risk of possible virus exposure. However, the quality and safety of using telemedicine for patients with back pain should be examined in further larger studies.

Remarks

The authors T. R. Jansen and M. Gathen contributed equally to this project and should be regarded as joint first authors. The authors K. Welle and K. Kabir contributed equally to this project and should be regarded as joint last authors. T. R. Jansen and K. Kabir are corresponding authors.

Conflict of Interest

The authors declare that they have no conflict of interest.

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