

## The influence of covid-19 pandemic on telemedicine in spine surgery

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### **Abstract**

*The onset of the novel coronavirus disease (COVID-19) pandemic and the social distancing measures to restrict the burst of infection rate both have vastly accelerated the use of telemedicine, where spine surgery was not an exception. While implementation of teleconferencing pertains to the pandemic era, telemedicine in spine surgery existed in pre-pandemic times as well. It was mainly used to facilitate communication between the patients and the physicians regarding the self-reported outcome measures after different spinal interventions. In this article we discuss the telemedicine practices in spine surgery that were present before the COVID-19 pandemic and the practices that were developed during the pandemic. We also discuss the methods used in our department. We conclude that telemedicine in spine surgery existed well before the Covid-19 pandemic, and had evolved significantly in terms of "live" patients' assessment during the first year of the health crisis. As medical professionals were pushed into an uncomfortable position, that opened the door to new concepts and proved they can work just as well as the old ones.*

## Vpliv pandemije covid-19 na telemedicino v kirurgiji hrbtenice

### **Povzetek**

*Pričetek pandemije bolezni novega koronavirusa (COVID-19) in z njim povezani ukrepi socialne distance, ki preprečujejo veliko število obolelih, so močno pospešili vpeljavo telemedicines, pri čemer kirurgija hrbtenice ni izostala. Doba pandemije je izpostavila predvsem telekonference, vsekakor pa je telemedicina v kirurgiji hrbtenice obstajala že pred pandemijo. Večinoma se je uporabljala za komunikacijo med zdravstvenim osebjem in pacienti v povezavi z vprašalniki kliničnega stanja po operacijah hrbtenice. V tem članku predstavljamo telemedicinske postopke, ki smo jih uporabljali pred pandemijo in postopke, ki smo jih pričeli uporabljati med pandemijo. Predstavimo tudi metode, ki se uporabljajo na našem oddelku. Zaključimo, da se je telemedicina v kirurgiji hrbtenice razvila že krepko pred pandemijo Covid-19, vendar se je med prvim letom pandemije znatno razvila, predvsem v smeri »žive« obravnave pacientov. Medicinski delavci so bili potisnjeni v neprijetno situacijo iz katere so razvili nove telemedicinske koncepte, za katere se je izkazalo, da so lahko ravno tako učinkoviti kot stari.*

## 1. INTRODUCTION

The onset of the novel coronavirus disease (COVID-19) pandemic and the social distancing measures to restrict the burst of infection rate both have vastly accelerated the use of telemedicine, where spine surgery was not an exception. While telemedicine in spine surgery had a stable presence and rise on some aspects of communication even before the pandemic [Kolcun et al., 2021], the development of communication technologies and the need for remote patient care have yielded additional novel principles of spine surgery telemedicine [Iyer et al., 2020].

It is believed that within surgical disciplines clinical remote encounters are oftentimes impractical of even non-feasible, as clinical examinations often involve physical interactions (neurological examination, wound checks, procedures). This limitation is particularly relevant in spine surgery as subtle clinical findings may influence decision making in terms of treatment planning and may need an in-depth discussion with the patients than usually occurs in a telemedicine setting [Kolcun et al., 2021]. Telemedicine using videoconferencing became an important strategy to reduce social contact during the pandemic, especially due to the fact that 80% of SARS-CoV2 infected individuals are asymptomatic carriers [Zhou et al., 2020]. Additional advantages include providing additional medical care to patients whose condition is not considered medically urgent for elective hospital admission; protecting healthcare workers and patients from the risk of SARS-CoV2 exposure and transmission; reducing patient backlog during social distancing measures; reducing demands on administrative staff for continuous rescheduling of appointments; maintaining financial viability of outpatient practice to cover hospital overhead costs [Liu et al., 2021].

While implementation of teleconferencing pertains to the pandemic era, telemedicine in spine surgery existed in pre-pandemic times as well. It was mainly used to facilitate communication between the patients and the physicians regarding the self-reported outcome measures after different spinal interventions [Kolcun et al., 2021].

In this article we discuss the telemedicine practices in spine surgery that were present before the COVID-19 pandemic and the practices that were developed during the pandemic. We also discuss the methods used in our department.

## 2. METHODS

We reviewed pubmed search engine for the search string “spine surgery telemedicine”. We reviewed the papers from 2019 to 2021 and their references. The papers were categorized into two groups based on the presence of pre-pandemic or post-pandemic telemedicine in spine surgery content. We extracted the major telemedicine categories and will present them in this paper.

## 3. RESULTS

The search sequence retrieved 71 papers on telemedicine in spine surgery which reveals a publication burst on the topic during the pandemic. After review of the titles and abstracts we used the articles that gave most accurate descriptions for the analysis.

### *Telemedicine in spine surgery before the pandemic*

Most studies described the use of telemedicine for communication facilitation between patients and the surgeons' office staff in the form of mobile phone apps for patients to self-report symptoms or functional status, online surveys, phone surveys, or online materials for education and consent. Other options described were internet-based systems with postoperative rehabilitation/exercise instructions; virtual postoperative follow-up visits; participation in an online support group for spinal fusion patients; and a physical activity measurement tool usage with the goal to compare the activity to patient-reported outcomes. [Kolcun et al., 2021]

### *Telemedicine for patient reported outcomes (PRO)*

Two different studies reported no significant difference between different PRO surveys (Oswestry disability index, SRS-22, SRS-30, and pediatric outcome data collected instrument - PODCI) when taken in a telephone, online or in-person manner [Bokshan et al., 2016, Nitikman et al., 2017].

### *Telemedicine for preoperative care*

A study investigated the use of a mobile application on the cancellation of spine surgery procedures due to patient non-compliance with the preoperative instruction. It was shown that the group using the application had no cancellation, while the group without the application had a 5% cancellation rate due to patient noncompliance [Stewart et al., 2019]. Another study evaluated a telemedicine online tool for preoperative education and surgical consent. Patients were randomized in a telemedicine setting and in a standard in-person setting. The patients had to take a test after the completed process where the telemedicine group did significantly better [Bethune et al., 2018].

### *Telemedicine for postoperative care*

In a postoperative setting different authors describe the use of mobile applications for postoperative monitoring of possible complications [Debono et al., 2016], postoperative rehabilitation/exercise implementation [Hou et al., 2019], and postoperative virtual visits [Thakar et al., 2018]. It has been shown that the patients considered the applications as beneficial and are satisfied with them in around 80%, patients who followed the online rehabilitation process had better long-term results in comparison to the standard “physical activity recommendations at discharge” strategy. Postoperative virtual visits were shown to be cost effective even if one third of patients later on needed an in-person visit.

### *Telemedicine for general clinical care*

Applications were developed and assessed in order to facilitate the process of general clinical care in spine surgery patients with the need of chronic physician supervision. It has been shown that a proper use of mobile applications can well match the repetitive in-person visits, while it does not predispose the patients to more adverse effects or complications. The applications can even be helpful in finding the complications early. [Dicianno et al., 2016]

### *Other telemedicine interventions*

A study followed a group of patients who engaged in an online support group for patients after lumbar fusion [Strom et al., 2019]. The online tool had similar results as the in-person standard support for patients. The authors found that women were more likely to engage in the support group.

One study compared physical activity measured by means of telemedicine with the self-reported clinical outcomes of the patients after spine deformity surgery [Scheer et al., 2017]. While the cohort was small and the follow-up relatively short, the authors conclude that remote monitoring of clinical activity after surgery should be furtherly investigated.

### *Telemedicine in spine surgery during the pandemic*

While telemedicine before the pandemic was mostly used for the administrative and communication purposes, the pandemic highlighted the need for a complete telemedicine patient assessment. Different authors early on started proposing methods of complete spinal clinical examination and investigation in order to provide the patients with sufficient care during the times of social distancing measures. We reviewed different approaches to telemedicine physical examinations of the spine and will present a compilation of different approaches that we feel fit best into our clinical setting.

We emphasize the importance of a standardized examination protocol, where we motivate the patients and have them understand why certain examination features they conduct are important for our assessment [Shafi et al., 2021]. Such protocol enables the patients not to lose focus, to feel comfortable with the examination plan, and the surgeon obtains the most valuable data that can be used for diagnostics and treatment planning [Iyer et al., 2020].

In order to perform the clinical examination, the physician and the patient need to guarantee the suitable technical equipment. The easiest way is by using a smart phone as most of the modern phone appliances enable recordings with an anterior and posterior camera, making both sides visualizing themselves and the other party at the same time [Kolcun et al., 2020]. For the patients with bigger corporal impairment or movement disorders we recommend a companion who can help them with movements and guide them through the examination [Shafi et al., 2021].

## GENERAL PHYSICAL EXAMINATION

### *Inspection and range of motion (ROM)*

The camera should be placed on to a desk or a lower cabinet with a distance of approximately 5 to 10 steps away from the patient, so the camera can film the entire standing position. The patient should turn towards the camera and the examiner should assess the differences in shoulder height, pelvic inclination or coronal plane deformity. Then the patient should turn to the side and we assess clear sagittal imbalance or other compensatory mechanisms (i.e. knee or ankle flexion).

Next step is the ROM of the cervical spine. We assess flexion, extension and lateral bending. We then continue with the thoracic and lumbar ROM: rotation, lateral bending and lumbar flexion and extension. We note all painful or symptomatic movements. We recommend placing a chair nearby for the elderly patients to assist with the body balance [Iyer et al., 2020].

### *Gait*

The patient walks 5 to 10 steps towards the camera, turns around 180 degrees and repeats the same number of steps in the opposite direction. Experience have proved this distance the optimal to assess gait disturbances (i.e. the Trendelenburg sign, drop foot sign, etc.) or asymmetries during the standing or swing phase of the step. We proceed with body balance assessment through the tandem gait (heel-toes). We recommend to conduct this part of examination next to a wall in case the patient loses balance. [Iyer et al., 2020]

## CERVICAL SPINE EXAMINATION (NECK AND UPPER EXTREMITIES)

### *Inspection and ROM*

The camera should be placed in a way we can see the head, the neck, the shoulders, the elbows and the hands. ROM of the cervical spine is generally conducted as a part of the general examination; however, it may be repeated at this point if more detailed examination is in place. We examine the ROM of the shoulder which provides us with the information of the impact of shoulder pathology on the clinical symptoms [Bokshan et al. 2, 2016]. We should examine flexion, abduction, internal and external rotation. The patients then show both of their palms into the camera to assess for the intrinsic muscles atrophy. We will not be able to see lesser changes; however, a clear difference should be seen in case of a thenar or interosseous atrophy.

### *Strength and sensibility*

We tell the patients to show us where on the skin they feel numbness, paresthesias or other sensory deficits. It is usually sufficient, but if we need more information, we can show the patients on our own arms how to conduct a pinprick test and to compare the symptomatic side with the non. symptomatic one. A toothpick or a paper pin may be used.

We test for upper extremities strength with a shoulder lift (trapezius), shoulder abduction (deltoid), antibrachial flexion (biceps), antibrachial extension (triceps), hand and fingers flexion and extension. If the patient can perform these movements with an approximately 3.5 kg weight (a book, a large teacup, etc.) we can vastly consider the strength to be at least 4/5 on a MMT scale. It is mainly important to check for strength asymmetry. It is hard to conclude a 5/5 strength in a remote environment, but one can easily find a difference between both sides. This is how we localize patients' problems and separate them from the painful sensations. [Iyer et al., 2020]

### *Special tests*

The modified Spurling maneuver is conducted so that we ask the patient to fully extend laterally bend the head in both directions. A propagation of symptoms to the ipsilateral side of the lateral bend marks a positive test [Anekstein et al., 2012].

The conductance of Lhermitte sign is also recommended, where the patient sits, slightly flexes the torso and then fully flexes the neck. A positive test is considered when the patient exhibits an electrical sensation along the torso, which shows for medullary compression [Khare et al., 2015].

### *Myelopathy assessment*

The telemedicine examination prevents us from conducting several clinical tests which are generally used to assess for myelopathy (the Hoffman sign, hyperreflexia, clonus). We may consider the use of the hyperextended fingers sign, the switching fingers test, and the 10 second marching test. We may also find instability at the tandem walk. For elderly or more severely impaired patients we may employ the Romberg test [Agrawal et al., 2009].

## LUMBAR SPINE EXAMINATION (LOWER BACK AND LOWER EXTREMITIES)

### *Inspection and ROM*

As listed above, we conduct this part of the examination as a part of the general examination. In case of low back pain, we ask the patient to move away from the camera and point the painful area or spot. This is especially useful to localize point pain and when the history points to sacroiliac pain or Bertolotti syndrome (pseudoarthrosis between the transverse process of L5 and the iliac ala). [Iyer et al., 2020]

### *Strength and sensibility*

Sensibility of the lower extremities is assessed in the same manner as on the upper extremities. The strength of the lower extremities is assessed with hip flexion (iliopsoas), knee extension (quadriceps), ankle dorsiflexion (tibialis anterior), hallux extension (extensor hallucis) and ankle plantar flexion (gastrocnemius-soleus complex). Lower extremities allow us to change the classical MMT testing for functional testing of the distinct muscle groups (walk on the toes – gastrocnemius, walk on the heels – tibialis anterior and extensor hallucis, rise from a sit-up – quadriceps, knee and foot liftoff – iliopsoas). The examiner must closely follow the movement and the body balance, and at the same time consider other pathologies that may cause such problems (hip, knee, ankle pathology). [Shafi et al., 2021]

### *Special tests*

Three special tests may be assessed during the telemedicine examination of the lumbar spine. A single foot stance test may reveal a L5 root problem when a quick body balance loss occurs. We must keep an eye on other pathologies that may cause similar symptoms (i.e. hip diseases). A five time rise from a chair test is conducted in a way where the patient stands from a sitting position and then sits back upon the examiner's call. If the patient is unable to perform 5 repetitions in 15 seconds that suggests a general functional leg disturbance. For the Lasegue test the patient flexes the hip while the knee is extended (lifts an extended leg from the surface). If the leg pain aggregates when the leg is over 30 degrees above the ground, we consider that a positive Lasegue sign, hence possibly a compression of L5 or S1. If the liftoff is mainly painful in the groin, a hip pathology should be suspected. In case the patient is unable to lift the leg up in a lying position, the Lasegue test may also be conducted in a sitting position where the patient extends the knee at 90-degree hip flexion. [Iyer et al., 2020]

## **4. DISCUSSION**

Our article has two main findings: (1) telemedicine in spine surgery existed before the onset of the Covid-19 pandemic, and (2) the Covid-19 pandemic caused the biggest health care crisis in the 21st century but also motivated the medical professionals to find new solutions in telemedicine to facilitate patients' treatment even during the social distancing measures.

Before the pandemic the telemedicine concept was mostly applied for communication and data gathering purposes including patient reported outcomes (PRO), pre-operative education and informed consent information, even for postoperative rehabilitation and exercise. All these concepts have previously been scientifically evaluated in different controlled studies and have been proven to yield similar or better results than the standard in-person execution [Bokshan et al., 2016; Nitikman et al., 2017; Bethune et al., 2018; Debono et al., 2016; Hou et al., 2019; Thakar et al., 2018].

After the onset of the Covid-19 pandemic and the implementation of social distancing measures to reduce the transmission of the virus and the burden of disease on the healthcare systems, basically all spine surgery activities but surgery itself had to be transferred to a telemedicine environment. Therefore, protocols on how to assess, examine and diagnose patients' problems were proposed [Iyer et al., 2020; Shaft et al., 2021]. Some authors even proposed how to convert traditional clinic into a telemedicine facility and how to select the appropriate patients that can benefit from telemedicine encounter [Liu et al., 2021]. A paper that was recently published concluded that only 8% of spine surgery plans changed upon in-person pre-surgical examination in comparison to the telemedicine examination [Crawford et al., 2021]. The other fields of orthopedic surgery had even less surgical plan changes. It is therefore safe to conclude that telemedicine may be a helpful tool to evaluate patients preoperatively as well.

In our daily practice we started using telemedicine in 2011. It started with the implementation of the SpineTango registry [Fritzell, 2002] into our clinical practice. Ever since we conduct a PRO communication with all of our surgical patients and input the surgical data along with ODI and COMI back and neck before surgery, after surgery and at 3, 6, 12, 24 months after surgery.

We also use telemedicine to communicate among the professional community. We exchange diagnostic imaging and perform medical consultations with other fields and in between our spine surgery team. The modern technology enables us to have a spine surgery consultant on call at home to review the emergency patients and make prompt decisions.

## 5. CONCLUSION

Telemedicine in spine surgery existed well before the Covid-19 pandemic, and had evolved significantly in terms of "live" patients' assessment during the first year of the health crisis. As medical professionals were pushed into an uncomfortable position, that opened the door to new concepts and proved they can work just as well as the old ones.

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