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Research Article

Agreement on Diagnosis and Management between Virtual Care and In-Person Clinical Care in a Tertiary Shoulder Centre

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Abstract

Purpose: Virtual care is becoming a norm in the field of orthopedic medicine. The purpose of this study was to examine the agreement between major diagnostic categories and management plan obtained through a virtual telephone encounter and in-person assessment in patients with shoulder conditions.

Methods: This investigation used a repeated-measure, intra-tester agreement design. The bias-adjusted and prevalence-adjusted Kappa (PABAK) values were calculated.

Results: Ninety patients were included in the telephone encounter, of whom 55 patients had an in-person assessment with an advanced practice physiotherapist (APP) and six had an in-person assessment with an orthopedic surgeon. The PABAK values were the lowest for impingement syndrome (0.54) and highest for frozen shoulder (0.90) and bicep pathology (0.96). The management plan showed moderate agreement with respect to ordering investigations and choice between conservative vs. surgical management.

Conclusion: This study provides preliminary information on the utility of a structured virtual telephone encounter prior to in-person assessments in a tertiary care shoulder clinic. Availability of the basic plain radiographs with an ultrasound or MRI in more complex cases is an important contributor to providing an effective virtual clinical encounter and arriving at a sound diagnosis and management plan.

Keywords: *Telephone Triage; Telemedicine; Shoulder; Extended Scope Physiotherapists*

Introduction

The word virtual comes from "virtue", meaning being something in essence, though not actually or in fact. Virtual visit in medicine refers to any remote interaction with patients through telecommunications technology without an in-person visit. While, virtual care has long been utilized in the musculoskeletal field [1-5], its utility and global implementation has exponentially increased due to recent restrictions on non-essential care during the pandemic of coronavirus disease 2019 (COVID-19) and the need to preserve health care resources. In the COVID-19 outbreak situation, having patients attend non-essential outpatient visits was considered unsafe and other modes of care delivery were highly recommended. It is expected that long after the incidence rates of the infection drop and fear of the disease has waned, virtual care will continue to be utilized to improve efficiency and access to care, particularly for patients where distance and travel poses challenges in accessing specialty care.

Physiotherapists are frontline health care workers providing essential care across the lifespan for acute and chronic conditions and evaluation of alternative models of care utilizing physiotherapists in advanced practice roles has shown promising results [6-10]. In the rapidly changing out-break environment, where providing remote care is required, their role remains vital. While virtual care is becoming a norm in the field of physiotherapy, the accuracy of clinical diagnosis made through a virtual structured telephone encounter is unclear. It is important to understand the advantages and limitations to various modes of care delivery and establish the reliability, accuracy, safety and effectiveness.

Purpose of the Study

The purpose of this pilot study was to examine the agreement between diagnosis and management plan reached through a structured telephone encounter and in-person assessment in patients referred to a tertiary care centre for a shoulder condition.

Methods

Design

This investigation used a repeated-measure, intra-tester agreement design.

Patients

All patients with a new referral for assessment to a tertiary care centre whose appointments were delayed due to the COVID-19 out-break during the first closure (April to July 2020) of the outpatient clinics were contacted via telephone by an experienced Advanced Practice Physiotherapist (APP). Patients were excluded from the study if they required a translator, could not describe their symptoms or physical limitations clearly, or had previous shoulder surgery.

After explaining the purpose of the telephone encounter as part of routine care during the pandemic closure, a comprehensive standardized history was obtained including detailed information regarding symptoms, mechanism of injury, ability to perform activities of daily living (ADL), and the treatments received to date. The APP had access to the results of the diagnostic investigations accompanying the referral. We followed all patients until they were assessed in-person by either the APP or surgeon, when permitted by the hospital between waves of COVID-19. Patients were removed from the wait list if they did not wish to have an in-person assessment or were seen elsewhere. The project received approval as a quality improvement activity and did not require a formal review by the Research Ethics Board of the local institute.

Clinical examination

The telephone interview was conducted by a senior physiotherapist with advanced postgraduate training (PhD) and more than 10 years' experience in the advanced-practice role. Considering the examination of range of motion and strength were not feasible via the telephone encounter, patients were asked about their ability to move their affected arm in three main planes and their limitations in performing specific daily activities.

Range of motion

Patients were asked if they could actively raise their arm above their head in front of their body with or without pain. Patients with full but painful active and passive elevation were categorized in the "full elevation" category. If they reported inability to lift the arm beyond 90 degrees, they were placed in the "limited elevation" category. If they had less than 90 degrees elevation and were unable to wash hair and reach behind back, they were placed in the "limited in all planes" category.

Based on the patient's response, the distinction between pain as the limiting factor, true capsular tightness (stiffness), and pseudoparalysis (severe weakness) was made by further questioning. In case of limitation in active elevation, patients were asked whether they could move the affected arm further passively by using the opposite hand. If they were unable to actively lift the arm beyond 90° but had preserved full passive elevation, they were considered to have a positive pseudoparalysis, a phenomenon that indicates significant rotator cuff insufficiency.

Activities of daily living

Patients who reported limitation in elevation were also asked if their movements were restricted in activities that involved external rotation (washing hair) and internal rotation (reaching behind back). The information on ADL limitations was used in relation to elevation categories to strengthen the presence of multi-plane stiffness and was not analyzed independently.

Imaging and diagnostic categories

The APP reviewed reports on the patient's diagnostic investigations including plain radiographs, ultrasonography (US), and magnetic resonance imaging (MRI), and reviewed radiographic images where available electronically. The working diagnosis was based on the patient's description of range of motion, activity limitation, and results of diagnostic investigations and was documented in six major categories: 1) impingement syndrome, 2) partial and full-thickness rotator cuff tear, 3) biceps pathology, 4) osteoarthritis of the glenohumeral joint, 5) frozen shoulder, and 6) cuff tear arthropathy with some patients having multiple and overlapping categories.

Management plan

Based on the working diagnosis, the APP provided all patients with recommendations for self-management during the COVID-19 clinic closure. The management plan involved education on the working diagnosis and nature of the condition, strategies for symptom relief and activity participation, and instructions on appropriate therapeutic exercises which were available through the hospital website as YouTube videos or mailed to the patient's address as a hard copy if requested. The APP documented the need for further investigations to be completed when required. Patients with a clear need for surgery were triaged directly to the surgeon for the next available in-person appointment. Patients without appropriate investigations, those who had a pathology that would not resolve without surgery but had minimum symptoms, and those who did not wish to undergo surgery at the time of assessment, were placed in the "maybe" category.

Statistical analysis

Descriptive statistics were calculated. The percentage of agreement (PA, number of cases agreed on divided by total number of cases), Kappa coefficient (κ), and their associated confidence intervals (CI), were used to determine agreement between clinicians. With hypothesis testing, it is advisable to evaluate the lower limit of the CI against a clinically meaningful minimum magnitude, such as 0.40, rather than against a zero value [11]. Strength of agreement was interpreted as suggested by Spratt [12]: < -0.20 = strong systematic disagreement; -0.20 to -0.01 = potential systematic disagreement; 0.00 - 0.20 = weak agreement; 0.21 - 0.40 = slight agreement; 0.41 - 0.60 = moderate agreement; 0.61 - 0.80 = good agreement; 0.81 - 0.90 = very good agreement; and 0.91-1.00 = excellent agreement. Considering the magnitude of Kappa is affected by the prevalence of the attribute and raters' bias which is related to the pattern of disagreement, we calculated the bias-adjusted and prevalence-adjusted Kappa (PABAK) values, using the formula suggested by Byrt and colleagues [13]: as $(2P_0 - 1)$, where P_0 is the observed agreement, calculated the same as the PA.

Results

From April to August 2020, 90 patients met the inclusion criteria and were included in the telephone encounter with the APP. Twelve patients were triaged directly for a consultation with a surgeon regarding surgery or for other reasons (one patient had adhesive capsu-

litis secondary to a work-related injury with an active claim, which is outside the scope of the APP clinic, and one had a chronic inflammatory rheumatoid arthritis). Seventy-eight patients were deemed appropriate for an in-person assessment with the APP. Of the 12 that were offered an in-person consultation with a surgeon, 6 did not attend; and, of the 78 offered an in-person consultation with the APP, 23 did not attend. The reasons for not attending the clinic visits were: symptoms had improved, managed elsewhere, or, did not wish to attend in-person during the COVID-19 pandemic. Data of 55 patients who had in-person assessment by the APP and 6 patients who had an in-person assessment by a surgeon from July to December 2020 were used for final analysis. There were no statistically significant differences in age (61 vs. 63) or female/male ratio (69% vs. 66%) of patients who attended an in-person assessment and those who did not ($p > 0.05$). Forty nine (80%) patients had an US or MRI or both with 29(48%) having results of plain radiographs on file. Table 1 shows the demographic data of the sample included.

Variable	N (%) or Mean (SD)
Sex	
Female	25 (41%)
Male	36 (59%)
Age (Mean, SD)	61 (14)
Range	21-89
Affected Side	
Bilateral	17
Left	13
Right	31
Side Examined	
Left	25
Right	36
Mechanism of Injury	
Insidious	27
Repetitive	6
Fall	13
Traumatic	11
Other	4
ADL	
Unable to wash hair	14 (23%)
Cannot reach behind back	27 (44%)
Sleep disturbance	
Yes	35 (57%)
Investigations available	
Plain radiographs	29 (48%)
Ultrasound	31 (51%)
MRI	25 (41%)
US&MRI	7 (12)

Table 1: *Demographics and characteristics of 61 patients.*

The level of agreement between ROM, diagnostic categories and management plan categories are shown in table 2. The PAs, Kappa and PABAK values on ROM categories varied from (PA = 79%, κ = 0.38, PABAK = 0.58) for the restricted in all planes category to (PA = 87%, κ = 0.69, PABAK = 0.74) for full elevation. Agreement on major diagnostic categories varied from (PA = 77%, κ = 0.39, PABAK = 0.54) for impingement syndrome to (PA = 98%, κ = 0.79, PABAK = 0.96) for biceps pathology. The agreement on investigations was moderate as some patients had additional investigations during the closure or "new" plain radiographs were felt required for the in-person assessment. The agreement on management plan with respect to surgical candidacy was 79% between three categories of yes, no and maybe (Table 2).

Variable	Telephone call interview	In-person Assessment	Kappa ($_{95\%}$CI), PABAK, PA
Range of motion*			
Full elevation above shoulder level	46 (75%)	40 (66%)	κ = 0.69 (0.49-0.88), 0.74; PA:53/61 = 87%
Elevation below 90 degrees	14 (23%)	19 (31%)	κ = 0.63 (0.41-0.84), 0.71, PA: 52/61 = 85%
• Weakness	• 6 (10%)	• 11 (18%)	κ = 0.67 (0.40-0.93), 0.77, PA: 56/61 = 92%
• Stiffness	• 11 (18%)	• 14 (23%)	κ = 0.52 (0.29-0.80), 0.71, PA: 52/61 = 85%
• Both	• 3 (5%)	• 6 (11%)	κ = 0.57 (0.21-0.93), 0.87, PA: 57/61 = 93%
Restriction in all directions	11 (18%)	16 (26%)	κ = 0.38 (0.12-0.84), 0.58, PA: 48/61 = 79%
Diagnostic categories			
Tendinitis/impingement	17 (28%)	13 (21%)	κ = 0.39 (0.12-0.64), 0.54, PA: 47/61 = 77%
Partial and Full Thickness RCT	29 (48%)	34 (56%)	κ = 0.64 (0.45-0.83), 0.64, PA: 50/61 = 82%
Biceps pathology	2 (3%)	3 (5%)	κ = 0.79 (0.39-1.00), 0.96, PA: 60/61 = 98%
OA GHJ (mild to advanced)	17 (28%)	24 (39%)	κ = 0.75 (0.56-0.91), 0.76, PA: 54/61 = 88%
Frozen shoulder	3 (5%)	4 (7%)	κ = 0.55 (0.09-1.00), 0.90, PA: 58/61 = 95%
CTA	0 (0%)	2 (3%)	N/A
Investigations required			
Plain radiographs	29 (48%)	36 (59%)	κ = 0.52 (0.30-0.72), 0.50, PA: 46/61 = 75%
US/MRI	9 (15%)	11 (18%)	κ = 0.64 (0.38-0.90), 0.80, PA: 55/61 = 90%
Surgical candidacy			
Yes	13 (21%)	20 (33%)	
No	30 (49%)	27 (44%)	κ = 0.65 (0.47-0.83), 0.58, PA: 48/61 = 79%
Maybe	18 (30%)	14 (23%)	

Table 2: *Agreement between range of motion and diagnostic categories and management plans.*
** overlapping categories*

Discussion

In March of 2020, the Canadian Ministry of Health encouraged all healthcare providers to implement a system for virtual care where possible to minimize the spread of COVID-19 and preserve healthcare resources. To quickly adapt and meet the needs of patients, the APP initially used a structured telephone encounter while processes for video assessment were being developed. We sought to observe the outcomes of the telephone encounter and understand its utility during COVID-19 and feasibility of obtaining an accurate diagnosis and appropriate management plan within limitations.

The present study showed that many informative components of clinical assessment such as the comprehensive patient history, restrictions in range of motion and ADLs could be obtained via the telephone encounter. Coupled with the information received from the referring physician on diagnostic investigations, it was feasible for the APP to arrive at a working diagnosis and management plan and make appropriate decisions on whether the patient would benefit from an in-person visit. These outcomes matched the in-person diagnosis and management plan in the majority of cases. While, there are limitations due to the lack of hands-on physical examination, using a structured telephone encounter provides sufficient information to triage for urgency, reach an accurate diagnosis within major diagnostic categories, and suggest a reasonable treatment plan.

Of importance, we found that patients under reported their ROM limitations. While 75% reported full elevation on the phone, only 66% had full elevation when examined in the clinic. One reason may be related to the patient's increased reliance on scapular contributions to overall humeral elevation, a phenomenon observed in patients who suffer from pain secondary to rotator cuff pathology. According to Scibek., *et al*. [14] pain serves as a primary contributor to increased scapulohumeral rhythm in patients with cuff pathology giving the illusion of a more normal elevation. With an in-person clinical assessment, the clinician stabilizes the scapula and accurately estimate the motion loss. This contributed to the higher number of actual limitations. In terms of diagnosis, the number of cuff tears and osteoarthritis in patients was underestimated in the virtual assessment. The discrepancy was mostly seen in patients with small tears or mild arthritic changes who did not have investigations available for the APP to review.

Challenges of shoulder assessment via telephone encounter

There are unique challenges to providing effective virtual care for patients with shoulder conditions, particularly when the clinician lacks direct observation of shoulder abnormalities and muscle weakness. The differentiation between pain-affected range of motion, true weakness secondary to large/massive rotator cuff tear, and stiffness caused by advanced osteoarthritis or adhesive capsulitis, is critical and patients require specific instructions to provide meaningful data to clinicians. In an in-person assessment, the clinician feels for capsular or bony hard endfeel at the termination of the range of motion, an important diagnostic cue that is missing in virtual assessment. In virtual assessment, the distinction between an advanced glenohumeral arthritis and adhesive capsulitis in younger patients is challenging; particularly, when marked crepitus and grinding is not reported by the patient and the plain radiographs are not available. The other important issue is the ability to distinguish between pure stiffness, and combined stiffness and weakness, where massive rotator cuff tear and secondary arthropathy coexist. The majority of cases referred to our tertiary shoulder program had sufficient investigations (31 had an US and 25 had an MRI with 7 patient having both) which helped with this differentiation. The study findings highlight the importance of educating primary care providers on appropriate imaging and what is required when referring patients to a tertiary care centre. While the US and MRI can provide valuable information on soft tissue pathology and cuff tear size, simple views of plain radiographs are often sufficient to rule out arthritis and large rotator cuff tears which manifest with superior subluxation of the humeral head with respect to the glenoid.

The important barriers to virtual care in the pre-pandemic era were the lack of technical knowledge, resistance to change, and lack of reimbursement for medical services provided [15]. With the spread of COVID-19 and its variants and the tremendous toll on human life since January 2020, this mode of care delivery has gained significant traction and many of the barriers have been addressed. At present, the literature on remote communication via telephone is limited to rheumatology populations with one study reporting satisfaction rates in orthopedic population [16]. In particular, in less well-resourced countries, the telephone encounter is more popular than videoconferencing with its more technological demands. In India, by March 2020, over 50% of the rheumatologists had employed telerheumatology consultations, using a variety of methods including personal smartphone devices [17]. A study that examined the impact of pandemic restrictions in the rheumatology practices in five different regions of Africa reported that use of telephone for consultation had increased to 60.5% [18]. In countries with more advanced health care systems, a similar trend of increased use of telephone encounters has been reported in patients with inflammatory conditions. An Australian clinical centre reported a remarkable success using tele-rheumatology for

up to 80% of the outpatient appointments [19]. The only orthopedic study that has used phone or videoconference virtual care reported a high satisfaction with telemedicine encounters by both patients and surgeons [16]. In this study, telemedicine encounter was successful in replacing an in-person visit, 78.4% of the time.

As it relates to patients with non-inflammatory conditions seen at tertiary care centres, the emerging literature on virtual care refers mostly to teleconferencing rather than use of a telephone. A number of studies have promoted virtual post-operative rehabilitation care using various modes of telemedicine [20-23]. Others have suggested virtual clinical examination techniques. In these studies, the virtual clinical tests suggested to facilitate remote examination are basically a modified version of traditional clinical tests using self-performance techniques. These studies, however do not provide any information on validity or reliability of these self-performed clinical tests [24-28].

There are limited studies that have examined agreement between virtual teleconferencing and in-person shoulder care [10,29]. In a study by Rabin., *et al*. [29] agreement between video telecommunication via a smart phone was compared with a face to face visit. The inter-test reliability was examined between two orthopedic surgeons, with one performing a virtual examination and one performing face to face examination. The agreement on diagnosis, use of additional diagnostic tests, and recommended course of management was assessed using PA and Kappa value coefficients. Traditionally, inter-tester reliability requires identical situation for examiners. In this study, a non-conventional reliability design was used, where the examination situation was quite different between the examiners. In a more rigorous design, both examiners would have been present at virtual and in-person assessment. This way agreement between two situations by one examiner (intra-examiner) and between two examiners in the same situation (inter-examiner) could have been properly examined. In the study by Rabin., *et al*. diagnosis was classified into eight distinct subgroups: rotator cuff disease (N = 9), instability (N = 5), superior labrum anterior posterior lesions (N = 7), adhesive capsulitis (N = 1), glenohumeral osteoarthritis (N = 1), post-operative follow-up, shoulder fracture, no clear diagnosis, and other (numbers not reported). The authors reported a PA of 85.1% and a Kappa coefficient of 0.82 ($CI_{95\%}$ 0.69 - 0.94) for agreement regarding diagnosis. It is not clear how the investigators arrived at only one Kappa value for nine diagnostic categories with such small numbers in each category. In our study, because of the low prevalence of the positive findings, the Kappa values underestimated the agreements and the PABAK values provided a clearer picture of the reliability for each category. The lowest agreement on impingement syndrome was related to its variable and wide clinical presentation, a fact that is confirmed by other studies [8] that have examined agreement between two clinicians in a traditional clinical setting. In this study the lowest agreement was reported on the impingement syndrome (PA = 75%, κ = 0.43). In another reliability study by Cottrell., *et al*. [10], 14 patients with shoulder complaints were seen via videoconferencing platform who were later seen in clinic. Of these 14 patients, 4 had the same diagnosis, 7 had similar diagnosis and 3 had a different diagnosis. The nature of the same, similar or different diagnostic categories was not revealed and it was not clear what type of pathologies (rotator cuff, osteoarthritis, instability, etc.) were examined. The percentage of agreement with respect to management was reported at 71.4%.

In terms of a need for additional diagnostic testing, Rabin., *et al*. reported PA = 74.5% and κ = 0.49. For the recommended course of management they reported 61.7% and 0.43 for PA and Kappa coefficients respectively [29]. In the present study, the agreement for plain radiographs was (PA = 75%, κ = 0.52) and better for more costly investigation being (PA = 90%, κ = 0.64). The reason for the higher number of plain radiographs ordered in-person were due to outdated views or lack of appropriate views. The disagreement in ordering US/MRI was only on six patients. The agreement on surgical candidacy if only yes and no categories were compared was high at κ = 0.84 (0.67 - 1.00), PA = 93%, but when the category of maybe was included, the agreement was reduced to κ = 0.65 (0.47 - 0.83), PA = 79%.

In summary, in line with rheumatology studies that have shown stable chronic diseases can be efficiently managed by telecommunication, the present pilot study that examined non-inflammatory shoulder conditions demonstrated that the use of the telephone provides a sufficient mode of triaging the majority of shoulder conditions. This study provides preliminary information on feasibility of obtaining a sound diagnosis and management plan via conducting a shoulder joint assessment using a telephone. Patients with plain radiographs and US/MRI will benefit the most from this viable mode of service delivery, increasing access to care in the era of pandemic and for patients

who live a distance from specialty care centres. It is expected that the use of videoconferencing where the examiner can observe the level of restrictions will improve the accuracy of the findings. Further assessment of reliability and validity of both telephone and videoconferencing assessment warrants investigation by a higher number of assessors and in larger and more diverse patient populations.

Conclusion

This study demonstrated that basic components of physical self-examination obtained remotely with the clinician's guidance, in addition to a comprehensive history and diagnostic imaging, can result in an accurate diagnosis and safe management plan for the majority of patients. At minimum, this alternative mode of care delivery assists with accurately triaging patients for in-person hospital visits and surgical assessment which will be of value post-pandemic.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Bibliography

1. Buvik A., *et al*. "Cost-Effectiveness of Telemedicine in Remote Orthopedic Consultations: Randomized Controlled Trial". *Journal of Medical Internet Research* 21.2 (2019): e11330.
2. Buvik A., *et al*. "Quality of care for remote orthopaedic consultations using telemedicine: a randomised controlled trial". *BMC Health Services Research* 16.1 (2016): 483.
3. Harno K., *et al*. "Clinical effectiveness and cost analysis of patient referral by videoconferencing in orthopaedics". *Journal of Telemedicine and Telecare* 7.4 (2001): 219-225.
4. Prada C., *et al*. "Results of a New Telemedicine Strategy in Traumatology and Orthopedics". *Telemedicine and e-Health* 26.5 (2020): 665-670.
5. Blank E., *et al*. "Early analysis of the United States Army's telemedicine orthopaedic consultation program". *Journal of Surgical Orthopaedic Advances* 20.1 (2011): 50-55.
6. Mir M and O'Sullivan C. "Advanced practice physiotherapy in paediatric orthopaedics: innovation and collaboration to improve service delivery". *Irish Journal of Medical Science* 187.1 (2018): 131-140.
7. Desmeules F., *et al*. "Advanced practice physiotherapy in patients with musculoskeletal disorders: a systematic review". *BMC Musculoskeletal Disorders* 13 (2012): 107.
8. Razmjou H., *et al*. "Evaluation of an advanced-practice physical therapist in a specialty shoulder clinic: diagnostic agreement and effect on wait times". *Physiotherapy Canada* 65.1 (2013): 46-55.
9. Razmjou H., *et al*. "Impact of Radiographic Imaging of the Shoulder Joint on Patient Management: An Advanced Practice Physiotherapist's Approach". *Physiotherapy Canada Fall* 69.4 (2017): 351-360.
10. Cottrell MA., *et al*. "Agreement between telehealth and in-person assessment of patients with chronic musculoskeletal conditions presenting to an advanced-practice physiotherapy screening clinic". *Musculoskeletal Science and Practice* 38 (2018): 99-105.

11. Sim J and Wright CC. "The kappa statistic in reliability studies: use, interpretation, and sample size requirements". *Physical Therapy* 85.3 (2005): 257-268.

12. Razmjou H., *et al*. "Intertester reliability of the McKenzie evaluation in assessing patients with mechanical low-back pain". *Journal of Orthopaedic and Sports Physical Therapy* 30.7 (2000): 368-389.

13. Byrt T., *et al*. "Prevalence and kappa". *Journal of Clinical Epidemiology* 46.5 (1993): 423-429.

14. Scibek JS., *et al*. "Rotator cuff tear pain and tear size and scapulohumeral rhythm". *Journal of Athletic Training* 44.2 (2009): 148-159.

15. Scott Kruse C., *et al*. "Evaluating barriers to adopting telemedicine worldwide: A systematic review". *Journal of Telemedicine and Telecare* 24.1 (2018): 4-12.

16. Rizzi AM., *et al*. "The new 'normal': Rapid adoption of telemedicine in orthopaedics during the COVID-19 pandemic". *Injury* 51.12 (2020): 2816-2821.

17. Gupta L., *et al*. "Management of rheumatic diseases in the time of covid-19 pandemic: perspectives of rheumatology practitioners from India". *Annals of the Rheumatic Diseases* 80.1 (2021): e1.

18. Akintayo RO., *et al*. "The impact of COVID-19 on rheumatology practice across Africa". *Rheumatology (Oxford)* 60.1 (2021): 392-398.

19. Cai K., *et al*. "The impact of COVID-19 on rheumatology clinical practice and university teaching in Sydney, Australia". *European Journal of Rheumatology* 7.2 (2020): S91-S93.

20. Kane LT., *et al*. "The role of telehealth as a platform for postoperative visits following rotator cuff repair: a prospective, randomized controlled trial". *Journal of Shoulder and Elbow Surgery* 29.4 (2020): 775-783.

21. Soegaard Ballester JM., *et al*. "Patient preference for time-saving telehealth postoperative visits after routine surgery in an urban setting". *Surgery* 163.4 (2018): 672-679.

22. Malliaras P., *et al*. "Internet and Telerehabilitation-Delivered Management of Rotator Cuff-Related Shoulder Pain (INTEL Trial): Randomized Controlled Pilot and Feasibility Trial". *JMIR mHealth and uHealth* 8.11 (2020): e24311.

23. Sabbagh R., *et al*. "The COVID-19 pandemic and follow-up for shoulder surgery: The impact of a shift toward telemedicine on validated patient-reported outcomes". *Journal of Telemedicine and Telecare* (2021).

24. Sprowls GR., *et al*. "The Shoulder Telehealth Assessment Tool in Transition to Distance Orthopedics". *Arthroscopy Techniques* 9.11 (2020): e1673-e1681.

25. Lamplot JD., *et al*. "The Virtual Shoulder and Knee Physical Examination". *Orthopaedic Journal of Sports Medicine* 8.10 (2020): 2325967120962869.

26. Tanaka MJ., *et al*. "Telemedicine in the Era of COVID-19: The Virtual Orthopaedic Examination". *Journal of Bone and Joint Surgery. American Volume* 102.12 (2020): e57.

27. Wahezi SE., *et al*. "Telemedicine During COVID-19 and Beyond: A Practical Guide and Best Practices Multidisciplinary Approach for the Orthopedic and Neurologic Pain Physical Examination". *Pain Physician* 23.4S (2020): S205-S238.

28. Laskowski ER., *et al*. "The Telemedicine Musculoskeletal Examination". *Mayo Clinic Proceedings* 95.8 (2020): 1715-1731.

29. Rabin A., *et al*. "Shoulder assessment by smartphone: a valid alternative for times of social distancing". *Archives of Orthopaedic and Trauma Surgery* (2021).

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