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Current Status and Prospect of Internet + Telemedicine in Rehabilitation of Patients after Rotator Cuff Repair

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Abstract: ***Arthroscopic rotator cuff repair, as an important treatment for rotator cuff tears, is one of the most common surgical methods in orthopedic s and traumatology, and rehabilitation is an important link affecting its prognosis. At present, the effect of conventional rehabilitation program is not very unsatisfactory, and Internet + telemedicine provides a new direction for the rehabilitation of patients after rotator cuff repair. The current impact of the epidemic makes telemedicine more important. This article summarizes the current status and development prospects of Internet + telemedicine in rehabilitation after rotator cuff repair.***

Keywords: Internet, Telemedicine, Rotator cuff repair, Rehabilitation**.**

1. Introduction

Arthroscopic rotator cuff repair is a commonly used clinical treatment for rotator cuff injury and has a high cost-effectiveness. With the increasing number of patients with rotator cuff injuries and improved arthroscopic techniques, most rotator cuff repair procedures can be performed arthroscopically, which has better outcomes and lower complication rates than previous incisional treatments. Rotator cuff injuries account for approximately 50% to 85% of shoulder diseases treated by clinicians. The risk increases gradually with age, reaching up to 31% in people aged 60 to 69 years, while it is expected to reach 65% in people over 80 years [1]. Comprehensive and effective rehabilitation guidance after surgery is the key to promote the recovery of shoulder joint function in patients, but due to pain, lack of understanding of the benefits of rehabilitation exercise, as well as poor patient compliance and other factors, the patient 'adherence rate to postoperative rehabilitation exercise gradually decreases [2-3].

Internet + telemedicine uses communication network technology to provide telemedicine through communication devices, smartphones and other tools. The development of telemedicine services can break the limitation of time and space. In the face of the current crisis of the new coronavirus pneumonia epidemic, doctors can more conveniently provide telemedicine services to patients. As a product of the rapid development of communication and digital technology, telemedicine is increasingly used in medical practice[4]. Foreign studies have reported[5-6] that the traditional rehabilitation treatment after rotator cuff repair is often difficult to achieve the expected rehabilitation effect due to the shortening of the length of hospital stay lacking the professional guidance of medical staff, psychological factors of patients, and poor patient compliance. Internet + telerehabilitation therapy uses web-based telerehabilitation platform, mobile terminal application software equipment, etc., which can well solve the problem of unsatisfactory rehabilitation results caused by the above reasons[7-11]. Combined with domestic and foreign literatures, the clinical application of telemedicine in the rehabilitation of patients after rotator cuff repair at present stage is reviewed, and its future prospects are discussed and prospected.

2. Current Status of Clinical Application of Internet + Telemedicine in Rehabilitation of Patients after Rotator Cuff Repair

2.1 Current Application Trend

At present, the application of Internet + telemedicine in the rehabilitation of patients after rotator cuff repair is mainly to build a communication platform between orthopedic surgeons and patients after rotator cuff repair through network communication technology, smartphone devices or various telemedicine platforms, so as to provide more direct and professional guidance for the rehabilitation diagnosis and treatment plan of patients. The main realization way is to establish a remote follow-up platform of rehabilitation system to replace the traditional outpatient review; after discharge, telemedicine is used as the continuation of traditional paper or oral instructions for rehabilitation guidance before discharge; and smartphone WeChat applet or computer and other equipment are used for remote monitoring real-time feedback and guidance of patient rehabilitation, achieving the clinical effect that cannot be achieved by the traditional follow-up method[12]. Correia FD[13] used digital telemedicine rehabilitation to compare with traditional home rehabilitation for rehabilitation after rotator cuff surgery, and the results showed that the effect of telemedicine was not inferior to traditional rehabilitation. Some researchers also believe that telemedicine is more effective than traditional rehabilitation modalities [14]. Kane LT et al. [15] conducted a prospective randomized controlled study of the role of telemedicine as a platform for presentation after rotator cuff repair and included 66 patients who underwent postoperative follow-up with telemedicine in the office at 2, 6, and 12 weeks after surgery. The results showed that a total of 58 patients (88%) completed the study (28 telemedicine vs. 30 controls). Patients in each group showed similar pain scores (P = .638, P = .124, and P = .951) and similar overall satisfaction scores (P = .304) at each follow-up visit. Patients in the telemedicine group showed a stronger preference for telemedicine compared to

the control group (P < .001). Overall, patients undergoing arthroscopic rotator cuff surgery were able to obtain safe and effective early postoperative follow-up care using telemedicine. The use of a telemedicine platform is a reasonable follow-up modality for patients seeking convenient and efficient care following arthroscopic rotator cuff repair. Parkes [16] introduced a virtual follow-up model in their regional hospital, where the investigators looked at the latest imaging images of the patients and a questionnaire filled by the patients through a web platform called MCO to assess the rehabilitation of the patients, and the results showed that the patient acceptance was high under the premise of good communication between the physician and the patient, but the patient satisfaction with complications or other problems during the follow-up was slightly lower. In a randomized controlled trial by Lim J Y et al. [17] 155 patients undergoing arthroscopic rotator cuff repair were randomly divided into telemedicine rehabilitation group and conventional rehabilitation group, no significant differences were observed in pain, range of motion (ROM), muscle strength and grip strength over time between the two groups. Outcomes showed significant improvement in both groups (all p < 0.001). No adverse events occurred during the intervention. Telemedicine rehabilitation significantly improved shoulder function and quality of life after rotator cuff surgery compared to conventional rehabilitation. Telemedicine rehabilitation is therefore effective and safe. Tang Xiumei [18] used WeChat applet to transmit the home exercise rehabilitation program to the subjects and their families, and the effect evaluation results showed that there was no significant difference in the effect of telerehabilitation compared with the control group guided by the paper exercise program (P > 0.05). A multicenter randomized controlled trial conducted by Tousignant et al. [19] found that telerehabilitation was less expensive than traditional rehabilitation, and telerehabilitation had a cost advantage when the distance between the patient 's home and the hospital exceeded 30 km, and the cost advantage was more pronounced the farther the distance. Recently, there has also been an increasing need for telerehabilitation in response to the epidemic of COVID-19. Another study showed that in addition to cost-effectiveness, telerehabilitation also has great advantages in the utilization of medical resources integration and human resources costs, which can effectively avoid the waste of medical care and human resources and have a certain promoting effect on reducing the burden on the medical system and patients [20].

Studies have found that patients treated with Internet + telerehabilitation have a better prognosis than patients treated with traditional rehabilitation. Mac ías-Hernández SI et al. [21] designed and created a telerehabilitation virtual service platform and conducted a clinical trial study, and recorded their pain level and function according to the Constant-Murley (CM) scale at baseline, 1, 2, 3, and 6 months. Results showed that pain decreased from a baseline value of 64 mm (range 40 – 80 mm) to 16 mm (range 0 – 30 mm) at 6 months (p < 0.001).The CM scale score increased from a baseline of 54 points (range, 51-66 points) to 85 points (range, 70-100 points) at Month 6 (p = 0.001).Functions of activities of daily living and work, mobility and strength showed significant changes at 6 months (p < 0.05). Dejan et al[22] have explored the use of mobile phone text messaging in medical treatment since 2011. Compared with traditional mobile phones, mobile phones can be used for video, animation, Internet and other means to further promote communication between doctors and patients in addition to the use of telephone information. To date, 18 studies have reported the use of the Internet and smartphones for postoperative telerehabilitation. Internet + telemedicine has become a new trend in postoperative self-management of patients[23]. Glasgow, Kim et al suggest that patients with software support are better than controls [24-25]. It can be seen that Internet + telemedicine will play a positive role in the rehabilitation of rotator cuff tear after surgery. Through remote guidance of mobile phones and activity-based capture devices, doctors can follow up the daily rehabilitation of patients, more accurately assess the training outcomes of patients throughout, develop more individualized rehabilitation plans, effectively improve the prognosis of patients, and overcome the shortcomings of traditional oral orders and pamphlet guidance.

2.2 Advantages of Internet + Telemedicine in Rehabilitation

Internet + telemedicine system can effectively ensure the quality of rehabilitation, reduce the number of hospital visits, save time and economic costs for patients after rotator cuff surgery in remote areas and urban areas with large population density[19]. Marsh et al.[26] compared telemedicine rehabilitation and outpatient routine rehabilitation instructions as well as postoperative follow-up. By analyzing 229 patients (118 telemedicine and 111 conventional rehabilitation instructions), the authors found that web-based patients were less costly. Rehabilitation plays a key role in the recovery after rotator cuff surgery, especially in the face of the current COVID-19 pandemic, telerehabilitation does not require real-time personnel supervision, which not only improves patient compliance, but also reduces patient medical costs, but also reduces the frequency of outpatient follow-up of patients at a special period, greatly reduces unnecessary contact between health care workers and patients, and effectively reduces the possibility of infection [27-29]. The results of a non-randomized controlled trial by Davidovitch et al. [30] also showed that telerehabilitation platform-assisted rehabilitation was more cost-effective.

It has been reported in the literature that telerehabilitation therapy can effectively shorten the postoperative hospital stay of patients. A randomized controlled trial by Roddey TS et al. [31] randomized 82 patients scheduled for arthroscopic rotator cuff repair to telerehabilitation versus conventional rehabilitation and followed them for 12 months. The results showed that there was no significant difference in the recovery of rehabilitation indexes between the two groups, and there was no significant difference in the incidence of complications and the rate of second admission, but the length of hospital stay in the telerehabilitation group decreased from 3.1 days (95% CI 3.0 ~ 3.3) to 1.1 days (95% CI 0.9 ~ 1.4, P < 0.001).

2.3 Analysis of Existing Problems

At present, although most hospitals in China have gradually established the Internet + telemedicine system, the technology is still in the development stage, and the professional

equipment that can collect the rehabilitation evaluation and movement data of postoperative patients in real time and accurately has not been widely used. The collection of patient data is mainly based on simple and passive monitoring items such as step count and distance measurement, and there is a lack of accurate measurement of patient joint activities, resulting in certain limitations in data analysis [32]. As a new type of medical model, Internet + telemedicine still has problems such as more processes and frequent operation at this stage. If grassroots medical staff do not receive professional systematic training, they cannot effectively use this new type of medical model. Coupled with the late start of the development of telemedicine in China, the publicity is not sufficient, and the publicity range is not wide enough. This has led to inadequate awareness of this medical model among health care workers and patients in remote areas. With the increase of age, people gradually decline in the ability to accept new things, resulting in some difficulty in the application of telemedicine in the elderly population. Sim et al [33] also pointed to this issue and raised the challenges faced by telemedicine including; (1) In the era of big data, telemedicine developed based on the Internet also has the risk of privacy disclosure; (2) The collection and clinical analysis of a large number of patient data are very complex; (3) The use rate of patients for the use of intelligent devices and telerehabilitation application software in the rehabilitation process has rapidly decreased; (4) The fragmentation of various types of rehabilitation data of patients in the telerehabilitation process and the interconnection in different applications also need to be solved urgently;

3. Application Prospect of Telemedicine in Rehabilitation of Patients after Rotator Cuff Repair

3.1 Telerehabilitation System based on Modern Mobile Communication and Artificial Intelligence Technology

At present, the research and practice of telerehabilitation in China are still in its infancy, and telerehabilitation technology services are weak. In the future, telerehabilitation can establish a channel for rapid communication between doctors and patients after rotator cuff repair based on mobile communication and artificial intelligence technology. Increasing the communication between doctors and patients also facilitates patients to timely receive preoperative and postoperative education. Doctors can understand the rehabilitation status and feedback of patients through the follow-up mode and evaluate the postoperative functional recovery of patients, so as to monitor the rehabilitation activities of patients and guide patients to correctly perform exercise, which is also more conducive to the development of individualized rehabilitation treatment plan.

According to the characteristics that big data and artificial intelligence system can automatically learn, a rehabilitation platform that can self-learn, self-renew and automatically respond to the needs of patients can be constructed, and more and more detailed knowledge about the prognosis of rotator cuff repair can be obtained from patients of different ages, different cultural levels, different regions and different languages according to different conditions of patients.

Today, participants in telerehabilitation, in addition to patients and health care workers, include engineers, commercial companies, and certainly academic researchers, and this multidisciplinary system design is bound to be a new trend in the future. Therefore, in the future development of telerehabilitation, it is necessary to strengthen multidisciplinary cooperation, improve technology, reduce costs, and protect patient privacy.

3.2 Broader Scope of Services

With the development of Internet technology, smartphones have become ubiquitous. Telerehabilitation therapy using smartphones with artificial intelligence technology can help doctors understand the progress of postoperative rehabilitation of patients and solve the problem of unbalanced medical resources for a long time. It provides physicians and patients with more options and allows more and more postoperative patients to enjoy more convenient rehabilitation [34].

Although it has great advantages, the development of telerehabilitation still faces many difficulties, such as the difficulty of the elderly population in operating the application software of mobile communication devices, which directly leads to the reduction of telerehabilitation acceptance. There is also a lack of professional training in rehabilitation systems and how to compensate for the lack of video guidance during telerehabilitation. Most of the existing evidence-based evidence is foreign literature, and there are few relevant studies in China. Therefore, future research should focus on China 's national conditions, develop personalized telerehabilitation program and create telerehabilitation platform system according to different characteristics of Chinese patients, and provide evidence-based evidence for the application of Internet + telerehabilitation in China.

4. Summary

The application of Internet + telemedicine in rehabilitation after rotator cuff repair is in the stage of rapid development, and policy support, technological innovation and market demand jointly promote its popularization. In the future, by integrating biomaterials, intelligent devices and personalized services, telerehabilitation is expected to become the core model of postoperative management and significantly improve the quality of life of patients and the utilization efficiency of medical resources. However, technological bottlenecks need to be broken through, regulatory frameworks improved, and patient education strengthened to achieve sustainable development.

References

[1] Doiron-Cadrin P, Lafrance S, Saulnier M, et al. Shoulder rotator cuff disorders: a systematic review of clinical practice guidelines and semantic analyses of recommendations [J]. Arch Phys Med Rehabil, 2020, 101(7): 1233-1242.

[2] Nicolson PJA, Bennell KL, Dobson FL, et al. Interventions to increase adherence to therapeutic exercise in older adults with low back pain and/or hip/knee osteoarthritis: a systematic review and

meta-analysis [J]. Br J Sports Med, 2017, 51(10): 791-799.
[3] Jansons PS, Haines TP, O'Brien L, Interventions to achieve ongoing exercise adherence for adults with chronic health conditions who have completed a supervised exercise program: systematic review and meta-analysis [J]. Clin Rehabil, 2017, 31(4): 465-477.
[4] Dorsey ER, Topol EJ. State of telehealth [J]. N Engl J Med, 2016, 375(2): 154-161.
[5] WilkeT, MüllerS. Nonadherenceinoutpatient thromboprophylaxis after major orthopedic surgery: a systematic review [J]. Expert Rev Pharmacoecon Outcomes Res, 2010, 10(6): 691-700.
[6] Li DW, Xu Y. The level and influential factors of joint function rehabiiitation in discharged patients undergoing hip replacement [J]. J Nurs, 2008, 15(8): 7-10.
[7] Eichler S, Rabe S, Salzwedel A, et al. Effectiveness of an interactive telerehabilitation system with home-based exercise training in patients after total hip or knee replacement: study protocol for a multicenter, superiority, no-blinded randomized controlled trial [J]. Trials, 2017, 18(1): 438.
[8] Fleischman AN, Crizer MP, Tarabichi M, et al. 2018 John N. Insall Award: Recovery of knee flexion with unsupervised home exercise is not inferior to outpatient physical therapy after TKA: A randomized trial [J]. Clin Orthop Relat Res, 2019, 477(1): 60-69.
[9] Bini SA, Mahajan J. Clinical outcomes of remote asynchronous telerehabilitation are equivalent to traditional therapy following total knee arthroplasty: A randomized control study [J]. J Telemed Telecare, 2016, 23(2): 239-247.
[10] Davidovitch RI, Anoushiravani AA, Feng JE, et al. Home health services are not required for select total hip arthroplasty candidates: Assessment and supplementation with an electronic recovery application [J]. J Arthroplasty, 2018, 33(7S): S49-S55.
[11] Correia FD, Nogueira A, Magalhaes I, et al. Home-based rehabilitation with a novel digital biofeedback system versus conventional in-person rehabilitation after total knee replacement: a feasibility study [J]. Sci Rep, 2018, 8(1): 11299.
[12] Fleischman AN, Crizer MP, Tarabichi M, et al. 2018 John N. Insall Award: Recovery of knee flexion with unsupervised home exercise is not inferior to outpatient physical therapy after TKA: A randomized trial [J]. Clin Orthop Relat Res, 2019, 477(1): 60-69.
[13] Correia F D, Molinos M, Luís S, et al. Digitally assisted versus conventional home-based rehabilitation after arthroscopic rotator cuff repair: a randomized controlled trial [J]. American journal of physical medicine & rehabilitation, 2022, 101(3): 237.
[14] KalronA, TawilH, Peleg-ShaniS, *et al*. Effectof telerehabilitation on mobility in people after hip surgery: a pilot feasibility study [J]. Int J Rehabil Res, 2018, 41(3): 244-250.
[15] Kane L T, Thakar O, Jamgochian G, et al. The role of telehealth as a platform for postoperative visits following rotator cuff repair: a prospective, randomized controlled trial [J]. Journal of Shoulder and Elbow Surgery, 2020, 29(4): 775-783.
[16] Parkes RJ, Palmer J, Wingham J, et al. Is virtual clinic followup of hip and knee joint replacement acceptable to patients and clinicians? A sequential mixed methods evaluation [J]. BMJ Open Qual, 2019, 8(1): e000502.
[17] Lim J Y, Shim G Y, Kim E H, et al. Postoperative Rehabilitation using Digital Healthcare System in Patients with Rotator Cuff Repair: A Randomized Controlled Trial [J]. 2022.
[18] Tang XM. The comparative study of remote rehabilitation nursing and traditional nursing after total hip replacement in elderly patients with femoral fracture [J]. Genom Appl Biol, 2019, 38(12): 5811-5816.
[19] Tousignant M, Moffet H, Nadeau S, et al. Cost analysis of inhome telerehabilitation for post-knee arthroplasty [J]. J Med Internet Res, 2015, 17(3): e83.
[20] Kingsbury SR, Dube B, Thomas CM, et al. Is a questionnaire and radiograph-based follow-up model for patients with primary hip and knee arthroplasty a viable alternative to traditional regular outpatient follow-up clinic? [J]. Bone Joint J, 2016, 98-B(2): 201-208.
[21] Macías-Hernández S I, Vásquez-Sotelo D S, Ferruzca-Navarro M V, et al. Proposal and evaluation of a telerehabilitation platform designed for patients with partial rotator cuff tears: a preliminary study [J]. Annals of rehabilitation medicine, 2016, 40(4): 710-717.
[22] Carter, E.L., G. Nunlee-Bland and C. Callender, A patient-centric, provider-assisted diabetes telehealth self-management intervention for urban minorities. Perspect Health Inf Manag, 2011. 8: p. 1b.
[23] Vervloet, M., et al., Short- and long-term effects of real-time medication monitoring with short message service (SMS) reminders for missed doses on the refi ll adherence of people with Type 2 diabetes: evidence from a randomized controlled trial. Diabet Med, 2014. 31(7): p. 821-8.
[24] Glasgow, R.E., et al., Engagement in a diabetes self-management website: usage patterns and generalizability of program use. J Med Internet Res, 2011. 13(1): p. e9.
[25] Kim, C.J. and D.H. Kang, Utility of a Web-based intervention for individuals with type 2 diabetes: the impact on physical activity levels and glycemic control. Comput Inform Nurs, 2006. 24(6): p. 337-45.
[26] Marsh J, Hoch JS, Bryant D, MacDonald SJ, Naudie D, McCalden R, et al. Economic evaluation of web-based compared with inperson follow-up after total joint arthroplasty. J Bone Jt SurgeryAmerican. 2014; 96: 1910–6.
[27] Eccleston C, Blyth FM, Dear BF, et al: Managing patients with chronic pain during the COVID-19 outbreak: considerations for the rapid introduction of remotely supported (eHealth) pain management services. Pain 2020; 161: 889–93
[28] Parisien RL, Shin M, Constant M, et al: Telehealth utilization in response to the novel coronavirus (COVID-19) pandemic in orthopaedic surgery. J Am Acad Orthop Surg 2020;28: e487–92
[29] Wosik J, Fudim M, Cameron B, et al: Telehealth transformation: COVID-19 and the rise of virtual care. J Am Med Inform Assoc 2020; 27: 957–62
[30] Davidovitch RI, Anoushiravani AA, Feng JE, *et al*. Home health services are not required for select total hip arthroplasty candidates: Assessment and supplementation with an electronic recovery application [J]. J Arthroplasty, 2018, 33(7S): S49-S55.

[31] Roddey TS, Olson SL, Gartsman GM, Hanten WP, Cook KF. A randomized controlled trial comparing 2 instructional approaches to home exercise instruction following arthroscopic full-thickness rotator cuff repair surgery. *J Orthop Sports Phys Ther*. 2002; 32(11): 548-559. doi:10.2519/jospt.2002.32.11.548

[32] Davidovitch RI, Anoushiravani AA, Feng JE, et al. Home health services are not required for select total hip arthroplasty candidates: Assessment and supplementation with an electronic recovery application [J]. J Arthroplasty, 2018, 33(7S): S49-S55.

[33] Sim I. Mobile devices and health [J]. N Engl J Med, 2019, 381(10): 956-968.

[34] Dorsey ER, Topol EJ. State of telehealth [J]. N Engl J Med, 2016, 375(2): 154-161.