

The Use of Online Video Consultations in the Aftercare of Orthopedic Patients: a Prospective Case-control Study

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Abstract

Background: Video consultations have proven to be a powerful support for patient-doctor interactions, not only at times of the Covid-19 pandemic. This study analyzed both patients' and doctors' acceptance of an orthopedic telemedical consultation (OTC) and compared the examination results of OTC to live consultation (LC) results for discrepancies.

Methods: The study was carried out in an orthopedic department of a German hospital between 2019 and 2020. After written informed consent, patients presented voluntarily for follow-ups by OTC and additionally in LC. Both patients and doctors were evaluated for their OTC experience and attitude (Likert-scaled and open questions, 26 to 28 items). The examination results of the OTC versus the LC were compared using a 12-items-checklist. Data was analyzed by quantitative and qualitative statistics.

Results: A total of 53 patient cases were included. The OTC atmosphere was rated as pleasant and the experience as very satisfying (average rating on 5-point Likert-Scale, with 1 as strong agreement: doctors: 1.2; patients: 1.3). Various technical and organizational challenges could be identified. OTC, compared to LC, showed no significant differences in patient history, and for results in inspection, palpation and active range of motion. Only in the functional or "passive joint assessment" LC showed a significantly higher suitability ($p < 0.05$) compared to OTC. Recommendations for further procedures as a result from the OTC, did not significantly differ from the LC.

Conclusion: Because of the positive acceptance and the objective benefit of OTC, with very similar clinical results to LC, OTC is recommendable for orthopedic follow-up examinations. In order to assess the functionality of a joint even better, meaningful digital alternatives for already established examination methods should be further investigated.

Background

In the context of the current digital transformation in medicine, digital approaches are used in a broad spectrum – starting from electronic systems for managing patient data, up to device-based support of medical tasks, or digital mobile services, so-called "Apps", serving as "mobile health" (1). Some innovations are even referred to as "disruptive technologies" due to their lasting changes to established offerings and processes (2).

Telemedicine is an almost "old" and broad term among digital tools. It involves the exchange of medical information between remote participants with the aim of creating a communication like a live consultation in order to improve the health of patients (3).

The experience with and the extent of established technical procedures vary between medical disciplines and also regions. For example, sending and receiving a remote diagnosis from data sets only, in medical specialties like radiology, has reached a high level of professionalism early on (4). For rural areas, experience with video-supported teleconsultation was also gained early (5).

However, it was for the improved Internet conditions on the one hand, and the partly new legal framework conditions of the past few years on the other hand, that the topic of online video consultation as a reliable treatment option was brought more into focus. In particular, the contact restrictions during the Covid-19 pandemic in 2020 increased the relevance of online video consultations for doctor-patient contacts in many countries (6).

Telemedicine in orthopedics has already been used in various countries (5, 7, 8). The first related studies at the end of the last century already showed that telemedical approaches could be used for outpatient orthopedic follow-ups (5).

In recent years, many advantages of online consultations have been proven, especially for orthopedics, but also for other disciplines.

That included making the consultation independent of the location, along with avoiding longer journeys for patients to see their doctor and thus decreasing longer absences from work (10), as well as reducing waiting times (9). For insurance companies, but also for health systems in general, a reduction of costs has already been reported (11, 12). Overall, the patient satisfaction increased, e.g., with the use of online tools in postoperative care compared to "classical" personal aftercare concepts (10, 13). The acceptance of such digital contact methods was described as very positive by patients in some study results (6), but could not always be reproduced (14).

Besides the satisfaction of patients and doctors with online video consultation, the aim of the present study was to investigate whether the examination results in of patients with orthopedic diseases would differ in comparison to a personal consultation. Additionally, we wanted to gain insights into the quality of consultations and their assessment by patients and doctors involved.

Materials And Methods

Study design and setting

Before the live follow-up consultation was planned, patients of the Department Traumatology and Orthopedics, Bundeswehr Hospital Berlin, were offered an additional follow-up by means of online video consultation. Voluntary participation was granted, and patients gave their informed consent, with the option to withdraw from the study at any time without giving reasons and without consequences for their treatment. Data acquired was pseudonymized. For both, the online and the live appointment, results were documented in standardized reports and saved in the hospital information system (HIS). It was part of the concept of this case-control study that any determination of the further therapy procedure was re-confirmed during the personal consultation. After the online appointment, the participating doctors were asked to assess their examination experience in an evaluation sheet, as were the patients for their consultation experience. The examination findings were evaluated comparatively using a self-designed evaluation sheet. The research project was approved by the responsible ethics committee (Ärztekammer Berlin, No.: Eth-12/19). The study began in August 2019 and lasted until July 2020.

Technical procedure

The real-time video conferences were conducted in accordance with applicable national law. End-to-end secure broadband connections between patients and doctors were established via a certified provider (Deutsche Arzt AG, Essen, Deutschland). Before the online appointment, the patients received a link, together with a password, by email or SMS and were thus able to log into a protected waiting area, where they were called by the doctor. The connection was achievable regardless of the end device (mobile phone, tablet, etc.), operating system or manufacturer.

Participation criteria

All participants of the study were soldiers of the German Federal Armed Forces, over 18 years of age, had the technical ability to use Internet-supported computer communication and participated voluntarily in the study after appropriate instruction.

Another prerequisite was a regular course of medical treatment. Exclusion criteria were, apart from the personal decision of the patients against participating in the study, any other situation in which - in the opinion of the treating doctors - continued participation in the study would not have been in the best interest of the patient.

Structure of doctor and patient questionnaires

The questionnaire for doctors contained 25 questions (closed 5-point Likert-scaled questions, half-open and open questions), which were subdivided into questions on demographic data (three questions), user preferences for digital services in the professional environment (five questions), general questions about the experience of the video consultation (punctuality, technical problems with contact, atmosphere) (four questions), special questions about the experience of the video consultation (including sound/image quality, examination procedure, improvement options) (13 questions).

The questionnaire for patients contained 27 questions (closed 5-point Likert-scaled questions, half-open and open questions), which were divided into questions on demographic data (two questions), usage preferences of digital services in the medical sector (three questions), general questions about the experience of the video consultation (punctuality, technical problems with contact, atmosphere) (four questions), special questions about the experience of the video consultation (including sound/image quality, examination procedure, improvement options) (12 questions), and questions comparing the OTC to normal consultation hours (including travel time, distance, experienced burden) (six questions). Patients were additionally asked for the perceived burden of the journey to the hospital under impression of live consultation.

Checklist of results on follow-up reports

Using a set checklist, two reviewers independently examined the examination reports of the online and the personal consultation. This 12-item checklist included questions with a 5-point Likert scale, closed selection options and free text answers: (one question on the topic of patient history, five questions on

findings, three questions on diagnostics, two questions on procedure and an open comment function. For patients presenting for wound controls only, the questions about the range of movement and functional examination were not applied.

Statistics

The collected data were entered in a Microsoft Excel spreadsheet (Version 2016, Microsoft Inc., Redmond, WA, USA). For the questionnaire data, a quantitative data analysis with evaluation according to descriptive statistical methods was performed. For the analysis of the examination reports we used IBM SPSS Statistics software (Version 23.0, IBM Corp., New York, USA). The correlation coefficient Cronbach's Alpha was determined for the independent reviewer ratings for evaluation objectivity. The Likert-scaled data of the comparison of OTC and LC was comparatively analyzed with the Mann-Whitney-U test. Free text answers were examined by two authors for recurring statements with a systematic qualitative content analysis according to Mayring (15).

Results

53 patients (male: n = 51, female: n = 2) and six doctors (male: n = 4, female: n = 2) were included in this study. The age of the participating patients was on average 36.4 (\pm 9.3) years. The average age of the doctors was 36.2 (\pm 2.6) years.

The clinical cases included 17 patients after shoulder surgery, 15 patients after knee surgery, 16 patients with wound control after various surgeries and five patients with other clinical presentations (one patient after osteotomy for leg axis correction, one patient after humerus and lower leg fracture, one patient after total hip arthroplasty for coxarthrosis, one patient each with conservative treatment of knee joint or shoulder joint complaints).

Evaluation of doctors' perception

With regard to the OTCs, the doctors evaluated almost all of the consultations as "very pleasant" (n = 48; 91%). In 66% (n = 35) of OTC, no problems had occurred, from the doctors' perspective. Problems (n = 18; 34%) during OTC indicated by the doctors were mainly of technical nature (n = 15; 28%). In one case, scheduling the appointment was cited as a problem, and in two cases other reasons for a problematic process were listed (poor Internet connection in the building, compatibility problems of the terminal device with the program). With regard to the transmission quality, in six cases the doctors were not at least satisfied with the sound, and in one case the image was not at least satisfactory (corresponding to a Likert-scale rating of three of five). The further evaluation results of the doctors' OTC experience are shown in figure 1.

In a concluding open question on possible improvements to support the implementation of the OTC, the doctors primarily indicated optimization in organization (n = 3) with fixed time slots for the OTC within the outpatient clinic's medical consultation hours (n = 3) and a minimization of technical problems, especially stable Internet connections (n = 8).

Evaluation of patients' perception

98% of all patients (n = 52) rated the atmosphere in doctor-patient contact during OTC as positive (53% (n = 28) as "immediately pleasant", 45% (n = 24) as "first unfamiliar, but pleasant in the following". Only 2% of the respondents found the atmosphere aloof and permanently unsettling. Patients reported no problems during OTC in 62% (n = 33) of the cases. Problems (n = 20; 38%) during OTC were mainly of technical nature (n = 16; 80%). In addition, in three cases, scheduling the appointment was cited as a problem and in one case the access code transmission was problematic. In only five cases, patients were not at least satisfied with the sound quality, and in one case the image quality was not at least satisfactory (corresponding to a Likert-scale three, one answer missing).

Figure 2 presents an overview of the means of transport chosen for the journey to the hospital, and the work loss in days.

In addition, the average distance traveled between point of stay and hospital was 170 km, with a maximum distance of 680 km. The average waiting time in the outpatient clinic was found out to be 30.7 minutes (± 27.87 , five missing answers) (compared to an almost punctual call at the OTC). The patients felt slightly to moderately impaired by the necessity of presenting in the outpatient clinic (4.2 on an average value scale of 0-10 (0 = not impaired at all; 10 = extremely impaired) (three answers missing). 36 % of the interviewed patients reported physical complaints or pain travelling to the hospital (three missing answers).

The further evaluation results of the patients' OTC experience are shown in Figure 1. In a concluding open question on possible improvements to support the performance of OTC, patients primarily indicated the elimination of technical problems (n=6), the use of image adjustment aids (e.g., selfie sticks) (n=3), the optimization of scheduling appointments (n=2), the provision of preparatory information for the performance of OTC (n=2) and the development of an application (n=1).

Checklist of results on follow-up reports

The patient reports of the 53 included cases were evaluated and compared regarding OTC and LC for different items (Cronbach's alpha for the independent reviewers: 0.802) (figure 3). Performing functional or "passive" motion tests worked significantly better in the LC group compared to the OTC group ($p = 0.031$).

In eight cases radiographic imaging was conducted during the live follow-up at the outpatient clinic (three X-rays; One CT scan; two MRIs; two ultrasounds). Out of these eight, four imagings were performed based on a predetermined appointment from the last follow-up, two were recommendations from the OTC and two were performed based on a new finding at the LC.

In only two cases, the OTC recommendation for further therapy did not correspond to the LC in the decisive core statements. In one case, patient's admission to the hospital for surgery was clear during

OTC, so determination of the exact procedure was left for the live contact. As for a second case, a different procedure was determined after X-ray control performed at LC.

Discussion

In the context of the current digital transformation of the health care system and before the background of the Covid-19 pandemic with reduced personal contacts, telemedicine is becoming more and more important, also in orthopedics (5, 7, 8). Because a complete restructuring of existing processes is necessary in some areas, telemedicine may even be seen as a disruptive technology (9).

The presented case-control study examined the benefits of an OTC among patients and doctors in the setting of orthopedic follow-up examinations. In particular, the technical feasibility, the doctor's assessment of usefulness and possible obstacles and challenges were analyzed. In addition, the study results of OTC and LC were compared in for each patient in order to make a statement about the quality of OTC and thus draw conclusions about the future use of OTC within the field of orthopedics.

One of the noteworthy results of the study was the positive evaluation of the OTC experience by patients and doctors. A clearly positive attitude towards recommending OTC to other patients or doctors was ascertainable, and at the same time the atmosphere during OTC was subjectively perceived as pleasant. Therefore, a previously described negative effect on the doctor-patient relation by mere online consultations, without personal interaction, could not be confirmed (14). It could be proven that orthopedic patients were satisfied with the performance of OTC within their treatment (16). One reason for a positive evaluation of OTC could be the familiar surroundings, indicated as an advantage by the patients, which is confirmed by the existing literature (17). But also, the potential elimination of long travel and waiting times helped made the patients evaluate the OTC positively. This is consistent with study results from other authors (9, 10, 18).

In the presented study, the OTC was mainly used for surgical aftercare. For this purpose, online consultations have already proven to be practicable in the literature (19, 20). Still, it must be stated that not all patients apply for online consultation only, and that online consultations should only accompany examinations in person (9). As a result, the OTC could help to focus the LC more on already well pre-diagnosed cases and those, who have started therapy – to the benefit of all involved.

In most of the cases the OTC ran without technical problems. However, in about one third of the conducted OTC challenges were still noticeable, which is comparable to findings in other studies (23, 24). In the course of this study, low bandwidth in rural areas in Germany were found as impairing for well-working consultations, which has already been described for other regions worldwide (19, 24). These problems require major attention, as they may lower the acceptance of telemedicine and the willingness to use it in the future (25). A strong and stable internet connection should thus be regarded as crucial and essential (19).

In addition to the good acceptance and the objective benefits of the technology, the study also demonstrated the comparatively good quality of the physician-patient consultation by comparing the findings of LC and OTC. Different studies have suggested that physical examination of patients with musculoskeletal diseases by telemedicine is very limited (26–28). However, the examination quality of medical history and inspection were nearly equivalent in this study. Similar results could also be demonstrated for the other sections of a physical examination, such as palpation and active range of motion. It has already been demonstrated that the examination of hip, knee, shoulder, and elbow joint, is well feasible using telemedicine. The examination quality could be increased by handing out a checklist to the patients in advance with preparatory information for the telemedicine consultation (22). Although in the presented study OTC have demonstrated limitations in terms of functional tests of a joint with classic examination methods, it seems that with the help of modifications to those functional tests and the use of assistive devices, it is possible to make reliable statements about this important component of the examination (21, 22). Most importantly, analyzing the established procedures in for each case individually, showed that the OTC recommendations for further treatment were similar to the live consultation recommendations in 96% of the cases. It therefore can be that decisions on further procedures can be made solely using OTC.

Additionally, in this study, we analyzed the distance from patients' residences to our clinic, the different forms of transportation, and the consumed time for LC that would have otherwise been spent for work commitments. We found that very long travel distances often had to be covered by the patients themselves. The fact that travelling and waiting times in the outpatient clinic were eliminated when using OTC, suggests that patients were committed for a much shorter period of time and thus would have been partly available to the employer (9, 10). Furthermore, patients that are in pain are not affected by the journey to the clinic or by any painful experience that may result from travelling. In addition to the patients themselves, other people were also involved (e.g., accompanying drivers). Next to this, almost 50 percent of the patients needed to drop out of work for at least half a day, unless they were already on sick leave. These factors indicate a significant strain on human and financial resources, which could be reduced by implementing OTC (11, 12, 29).

The study has some limitations. Firstly, the direct comparison of the OTC with a live study cannot guarantee the objectivity of double-blind, randomized, controlled studies. Secondly, it must be critically noted that there was no time recording of the duration of the online and live investigation, which would have provided an important additional measure of effectiveness when compared to each other. Finally, the number of selected patient cases is not large and comprehensive enough to make a statement for all orthopedic disease entities. The voluntary nature of participation could also have led to a biased selection. Participants who were already interested in digital topics might have been more willing to participate in studies on this topic. In the future, more patients should be included with a wider range of age and a more balanced gender distribution.

Conclusion

Based on the findings of this study, it seems to be advisable to establish an OTC in an orthopedic clinic, since it is able to offer good options for the follow-up examination of orthopedic patients. In addition, it offers advantages for the treating doctors and patients, such as saving time, avoiding long journeys to the clinic, and maybe even a reduction in material and personnel costs. The limitations in orthopedic examinations, suggest digital adaptations of functional tests. Technical problems need to be identified and analyzed in order to minimize them in the daily clinical routine.

Declarations

Role of funding

The funding of the entire project (No. 23K4-S-10 1921) on orthopedic telemedical consultation was granted by the Medical Service of the German Armed Forces.

Competing interests

The authors declare no conflict of interest.

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request

Code availability

Not applicable for that section.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was written by the first author and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics approval

The research project was approved by the responsible ethics committee (Ärztekammer Berlin, No.: Eth-12/19). We confirm that all methods were performed in accordance with the relevant guidelines and regulations of the ethics committee of the *Ärztekammer Berlin*.

Consent to participate

Participation was voluntary, and study participants gave informed written consent.

Consent for publication

Not applicable.

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Figures

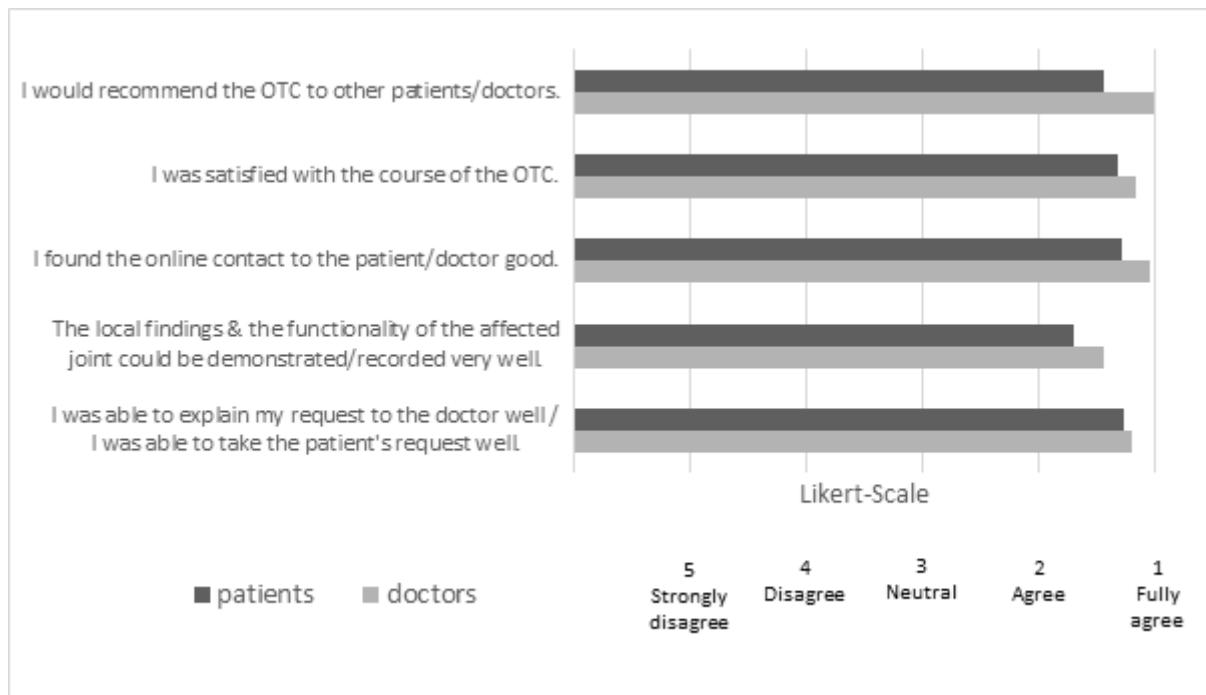


Figure 1

Evaluation of the experience of the performed OTC ($n = 51$) by patients and doctors (5-point Likert-Scale).

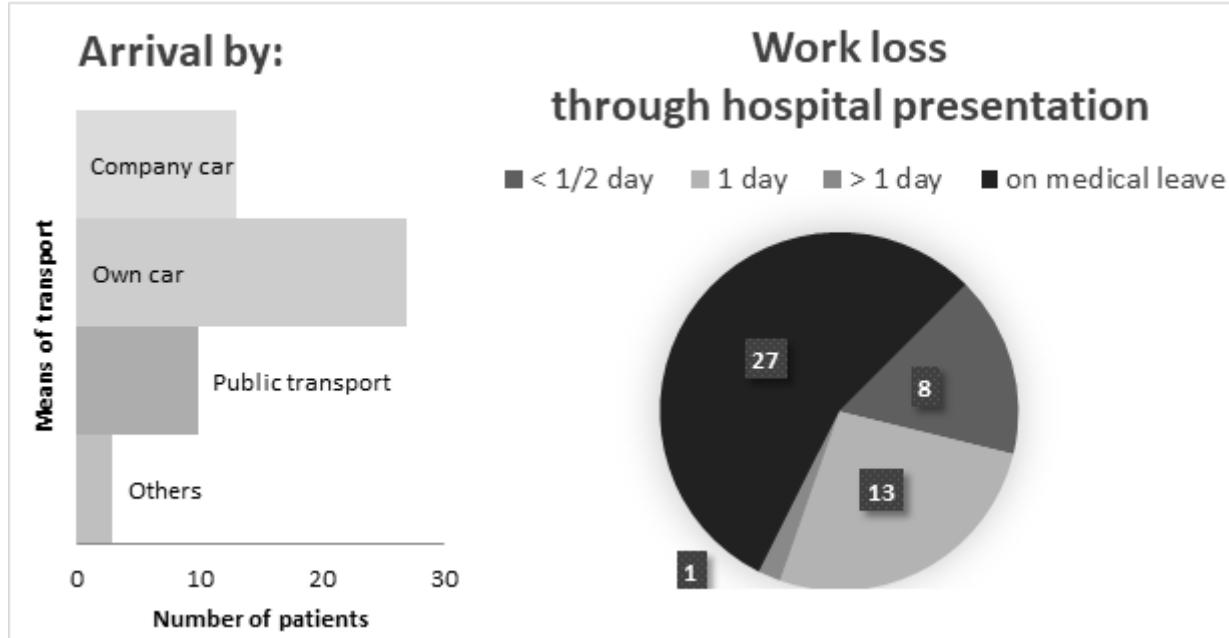


Figure 2

Mode of transport/arrival of the patients to the live consultation and their estimated loss of working time due to the presentation in the hospital (n = 48).

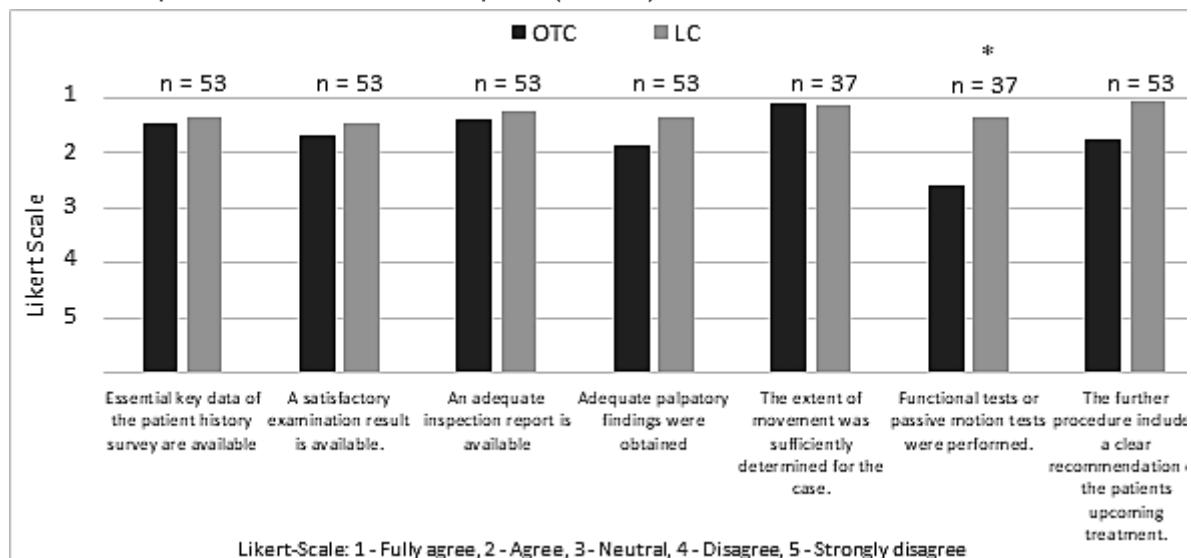


Figure 3

Comparison of scores for the quality of ascertained medical history, clinical examination aspects and further treatment recommendation in OTC and LC (* p = 0.031) (n = 51; no evaluation of range of motion and functional tests for patients with check-up for wounds only, n = 16).