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# Utilization and Impact of Telemedicine in Orthopaedic Practice: A Cross-sectional Study

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**Abstract**

*The integration of telemedicine into modern healthcare has revolutionized the delivery of medical services, particularly during and after the COVID-19 pandemic. Among various specialties, orthopaedics—traditionally reliant on physical examination and radiological investigations—has experienced both opportunities and challenges in adopting telemedicine platforms. This study aims to assess the utilization, effectiveness, patient satisfaction, and barriers associated with telemedicine in orthopaedic practice, with a particular focus on outpatient care, follow-up visits, and post-operative management.Conducted as a cross-sectional observational study in a tertiary care teaching hospital, the research involved both orthopaedic practitioners and patients who participated in teleconsultations over a six-month period. Data were collected through structured questionnaires, electronic records, and patient feedback forms. A total of 250 patients and 15 orthopaedic consultants were included. Key parameters assessed included accessibility, diagnostic accuracy, communication quality, satisfaction levels, and clinical outcomes. The study also explored technical challenges, physician adaptability, and medico-legal concerns associated with remote consultations.The results revealed that 78% of patients found telemedicine to be a convenient alternative to in-person visits, particularly for follow-up care and minor musculoskeletal complaints. Over 65% of patients reported satisfaction with the consultation quality, while 82% appreciated the cost savings and reduced travel time. Among the practitioners, 60% felt confident in managing cases like joint pain, physiotherapy guidance, post-operative wound inspections, and second opinions via telemedicine. However, limitations were evident in cases requiring physical manipulation, fracture assessment, or emergency interventions. A significant challenge identified was the lack of adequate training among clinicians and patients in handling digital tools, leading to communication delays or incomplete evaluations in 18% of cases.*

*The study also highlighted that patient satisfaction was significantly higher when consultations were supplemented with prior imaging reports, clear communication, and structured telemedicine protocols. Additionally, elderly patients and those from rural areas exhibited*

*comparatively lower digital literacy, necessitating support systems for effective interaction. On the legal front, most practitioners expressed concerns about unclear medico-legal boundaries and liability in the event of misdiagnosis or treatment delays. Despite these issues, both patients and physicians agreed that telemedicine played a vital role in maintaining continuity of care during the pandemic and has the potential to augment the existing healthcare delivery system in the long term.In conclusion, telemedicine in orthopaedics offers a viable, cost-effective, and patient-friendly approach, especially for non-emergency consultations, follow-ups, and chronic musculoskeletal conditions. While it cannot completely replace face-to-face evaluations, its integration into routine orthopaedic care can significantly improve accessibility and efficiency when supported by proper training, regulatory frameworks, and digital infrastructure. The findings of this study provide valuable insights into optimizing telemedicine usage in orthopaedics and offer a roadmap for policymakers, healthcare providers, and educators to design more inclusive and effective telehealth systems tailored to the needs of orthopaedic patients.*

**Keywords:** ***Telemedicine,Orthopaedics, Virtualconsultation, Remotehealthcare, Patientsatisfaction, Post-operative care, Musculoskeletaldisorders, Digital health***

## Introduction

The healthcare sector has undergone a remarkable transformation over the past decade with the advent and progressive adoption of digital technologies. Among these innovations, **telemedicine** has emerged as one of the most significant developments, enabling the remote diagnosis, treatment, and management of patients via telecommunications technology. While telemedicine has long existed in various forms, its role was dramatically magnified during the COVID-19 pandemic, when physical distancing protocols and overburdened hospitals necessitated the widespread adoption of virtual healthcare delivery systems. Across medical specialties, telemedicine proved to be a lifeline that sustained healthcare continuity. However, the experience and adaptability of different specialties varied significantly. One such specialty where the potential and limitations of telemedicine continue to be explored is **orthopaedics**.

Orthopaedics is a surgical specialty that primarily deals with the diagnosis, correction, prevention, and treatment of disorders of the bones, joints, ligaments, tendons, and muscles. Traditionally, orthopaedic care has been perceived as heavily dependent on **physical examination, imaging modalities, and in-person interventions**, which has led to some skepticism regarding the applicability of telemedicine in this field. However, the pandemic-induced shift in healthcare paradigms prompted orthopaedic practitioners to reconsider and experiment with virtual modes of consultation, particularly for non-emergency cases, follow-ups, and physiotherapy guidance.The potential of telemedicine in orthopaedics is vast. Remote consultations can facilitate the **triaging of patients**, ensuring that those in need of urgent care are

prioritized for hospital visits, while others with non-urgent or chronic conditions are managed remotely. Post-operative patients who require wound inspection, physiotherapy instructions, or general recovery guidance can benefit from the convenience and reduced infection risk of virtual check-ins. Furthermore, telemedicine enables **rural and underserved populations** to access orthopaedic specialists without the burden of long-distance travel, which is especially valuable in countries like India where there is an uneven distribution of healthcare resources.

Despite its promise, there are substantial challenges in the implementation of telemedicine in orthopaedics. One of the primary concerns is the **lack of physical contact**, which limits the physician's ability to palpate, manipulate joints, assess the range of motion, and detect subtle clinical signs that are critical in musculoskeletal diagnosis. Technical limitations, such as poor internet connectivity, lack of access to smartphones or computers among certain patient populations, and inadequate digital literacy, further hinder the effectiveness of telemedicine consultations. Additionally, there are **legal and ethical issues**, such as concerns over data privacy, malpractice liability, and the absence of clear guidelines in many regions, which pose barriers to the widespread adoption of telemedicine.

From the physician's perspective, the transition to telemedicine requires **retraining and reorientation**. Many orthopaedic surgeons are trained in conventional clinical methods and may lack the experience or confidence to manage patients effectively in a virtual setting. The absence of standard protocols, validated virtual assessment tools, and proper electronic documentation practices makes it difficult to ensure consistent quality of care across providers. Moreover, telemedicine requires investment in **infrastructure, scheduling systems, video conferencing platforms, and electronic health records**—resources that may not be readily available or affordable in all healthcare settings.

Patient perspectives on telemedicine also vary. While some patients appreciate the convenience, cost-effectiveness, and reduced waiting times associated with virtual visits, others feel that remote consultations are impersonal and less reassuring. In the context of orthopaedics, where treatment plans often include physical rehabilitation, patient education, and long-term follow-ups, the importance of **effective communication and trust** cannot be overstated. Studies have shown that patients are more likely to adhere to treatment recommendations when they feel understood and engaged, which can be a challenge in a digital environment.

In light of the above, it is essential to explore how telemedicine is being utilized in real-world orthopaedic settings, what types of cases are most suitable for remote management, what limitations are being encountered by both clinicians and patients, and how these experiences can inform future practices. **This study was designed to systematically evaluate the usage patterns, perceived benefits, patient satisfaction levels, challenges, and limitations of telemedicine in orthopaedics** in a tertiary care teaching hospital in North India.

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The study also seeks to understand the **demographic and technical factors** that influence the success of teleconsultations, such as the age and education level of patients, prior familiarity with digital tools, availability of imaging reports, and the quality of audio-visual communication during consultations. Special attention is given to identifying which subdomains within orthopaedics—such as trauma, degenerative joint diseases, sports injuries, or post-operative care—are more amenable to telemedicine solutions.

Furthermore, the study attempts to bridge the gap between theory and practice by analyzing the **real-life experiences of orthopaedic practitioners** who have incorporated telemedicine into their clinical workflows. Their feedback on diagnostic accuracy, clinical decision-making, medico-legal concerns, and overall satisfaction can offer valuable insights for the development of standardized protocols, training modules, and policy frameworks aimed at optimizing telemedicine utilization.

From a broader perspective, this research contributes to the growing body of evidence supporting **hybrid healthcare models**, where digital and in-person services are integrated to provide patient-centric, accessible, and high-quality care. Such models can enhance the efficiency of healthcare systems, reduce the burden on tertiary hospitals, and ensure timely intervention for patients in remote or underserved areas. In a country like India, where access to specialized healthcare is still a challenge for a large segment of the population, leveraging telemedicine in orthopaedics could significantly improve health outcomes and reduce the economic burden on both patients and the healthcare system.

In conclusion, while telemedicine is not a panacea and cannot replace all aspects of orthopaedic care, it holds considerable promise as a complementary tool for enhancing the reach and responsiveness of orthopaedic services. By systematically evaluating the current trends, benefits, and limitations, this study aims to provide evidence-based recommendations for integrating telemedicine into standard orthopaedic practice, particularly in resource-constrained settings.

## Materials and Methods

### Study Design

This study was designed as a **cross-sectional observational study** to evaluate the utility, effectiveness, satisfaction levels, and limitations of telemedicine services in orthopaedic outpatient care. The study was conducted at the Orthopaedics Department of a tertiary care teaching hospital in North India over a period of **six months** .

The study received ethical clearance from the Institutional Ethics Committee. Informed consent was obtained digitally or verbally from all participants involved in the telemedicine consultations.

**Objectives**

- To evaluate the types of orthopaedic cases managed through telemedicine.
- To assess patient satisfaction and clinical outcomes of teleconsultations.
- To analyze the technical and clinical challenges faced by both patients and practitioners.
- To recommend best practices for integrating telemedicine in orthopaedic practice.

**Study Population**

The study involved two primary groups:

1. **Orthopaedic patients** who availed of telemedicine services during the study period.
2. **Orthopaedic consultants and residents** who provided teleconsultations.

**Inclusion Criteria (Patients):**

- Adults (≥18 years) with musculoskeletal complaints managed via telemedicine.
- Patients with access to a smartphone or computer with video calling facility.
- Patients who completed at least one teleconsultation session.

**Exclusion Criteria (Patients):**

- Patients requiring emergency surgical intervention.
- Patients unwilling to participate or unable to give consent.
- Patients without internet access or basic digital literacy.

**Inclusion Criteria (Doctors):**

- Orthopaedic surgeons and postgraduate residents who conducted teleconsultations.
- Minimum 1 month of experience in telemedicine practice.

**Sample Size and Sampling Technique**

A **convenience sampling method** was used. During the 6-month period, **250 patients** and **15 orthopaedic doctors** who fulfilled the inclusion criteria were included in the study.

**Mode of Teleconsultation**

The hospital's telemedicine service was conducted via:

- **Video calls (using WhatsApp, Zoom, or Google Meet)** for detailed assessments.
- **Phone calls** for follow-up discussions and prescription renewals.
- **Text messages or emails** for sharing prescriptions, radiology reports, and physiotherapy protocols.

**Data Collection Tools**

Structured **questionnaires and feedback forms** were used for data collection from both patients and doctors.

**1. Patient Questionnaire (Post-Consultation):**

- Demographics (age, gender, education, residence)
- Type of complaint
- Satisfaction with ease of use, doctor's communication, diagnosis clarity, etc.
- Technical issues (audio/video clarity, network issues)
- Preference: teleconsultation vs. in-person visit
- Willingness to use telemedicine in the future

**2. Doctor Feedback Form:**

- Type of cases handled
- Clinical confidence (rated on 5-point Likert scale)
- Diagnostic and treatment challenges
- Time efficiency and patient interaction
- Technical or ethical concerns

**3. Clinical Record Review:**

- Type of diagnosis (fracture, arthritis, post-op care, etc.)
- Imaging availability
- Follow-up and outcome (recovery, further intervention required)

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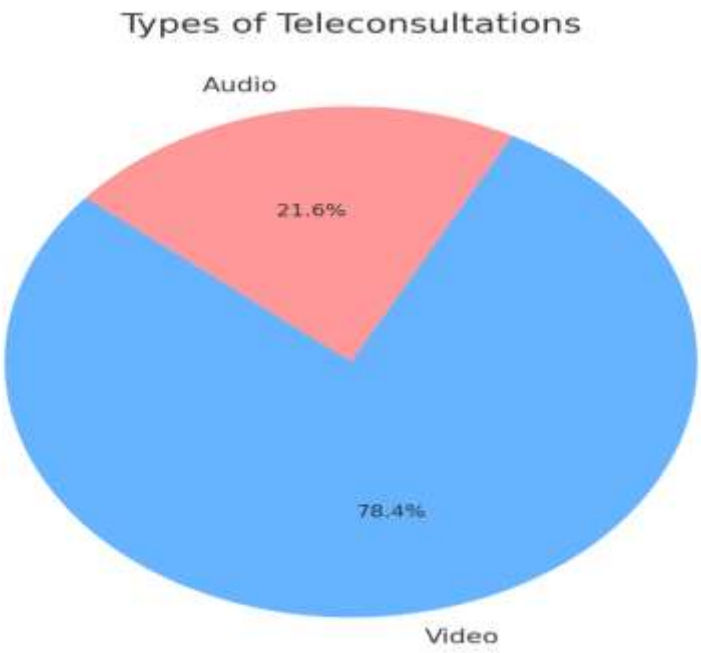


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**Table 1: Demographic Profile of Patients (n = 250)**

| Variable | Category | Frequency (%) |
|---|---|---|
| **Gender** | Male | 142 (56.8%) |
| | Female | 108 (43.2%) |
| **Age Group** | 18–30 | 40 (16%) |
| | 31–50 | 108 (43.2%) |
| | 51–70 | 74 (29.6%) |
| | >70 | 28 (11.2%) |
| **Location** | Urban | 160 (64%) |
| | Rural | 90 (36%) |
| **Education Level** | Illiterate | 12 (4.8%) |

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| Variable | Category | Frequency (%) |
|---|---|---|
| | Upto 10th Standard | 76 (30.4%) |
| | Graduate and Above | 162 (64.8%) |
| **Digital Literacy** | Able to handle video consultation | 198 (79.2%) |
| | Required assistance | 52 (20.8%) |

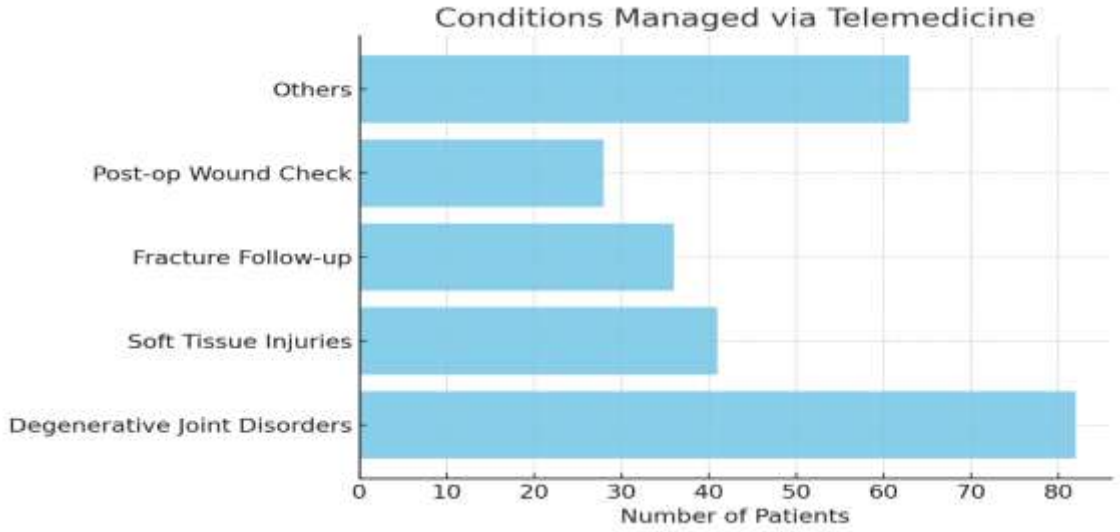


**Table 2: Classification of Orthopaedic Conditions Treated via Telemedicine**

| Orthopaedic Condition | Number of Patients | Percentage (%) |
|---|---|---|
| Degenerative joint disorders (e.g., OA) | 82 | 32.8% |
| Soft tissue injuries (sprains/strains) | 41 | 16.4% |
| Fracture follow-up | 36 | 14.4% |
| Post-operative wound check | 28 | 11.2% |
| Back pain / Cervical spondylosis | 25 | 10.0% |
| Physiotherapy follow-up | 22 | 8.8% |

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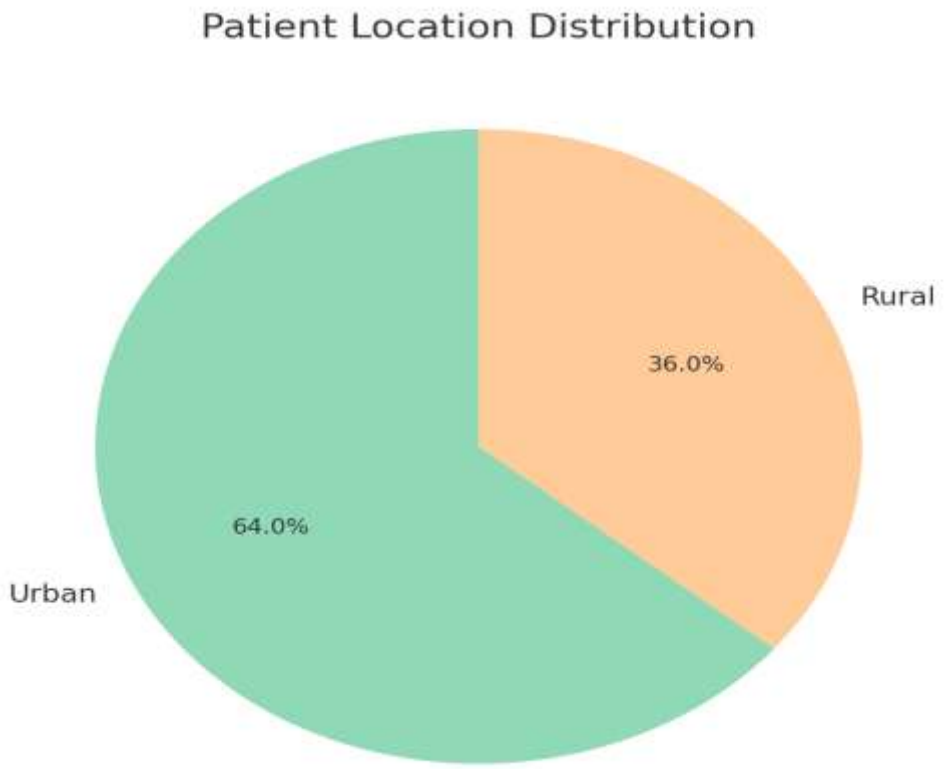
| Orthopaedic Condition | Number of Patients | Percentage (%) |
|---|---|---|
| Pediatric orthopaedic consultation | 9 | 3.6% |
| Others | 7 | 2.8% |




**Data Analysis**

- All data were compiled using **Microsoft Excel**.
- Statistical analysis was conducted using **SPSS version 25**.
- **Descriptive statistics** (percentages, means, standard deviation) were used to analyze demographic variables and patient/doctor responses.
- **Chi-square tests** were applied to identify associations between demographic factors (e.g., age, education) and satisfaction with teleconsultations.

- **Likert scale ratings** were analyzed to determine average satisfaction scores and clinical confidence levels among doctors.

**Key Variables**

| Variable Name | Type | Scale/Category |
|---|---|---|
| Age | Independent | Continuous (years) |
| Gender | Independent | Male/Female |
| Type of Orthopaedic Issue | Independent | Categorical |
| Satisfaction Score | Dependent | 5-point Likert scale (1–5) |
| Clinical Outcome | Dependent | Recovered / Partially / Referred |
| Technical Issues | Dependent | Yes / No |

**Ethical Considerations**

- All patient data were kept confidential and stored in password-protected systems.
- Verbal or digital consent was recorded at the start of each teleconsultation.
- The study adhered to the **Indian Medical Council (Professional Conduct, Etiquette and Ethics) Regulations** and the **Telemedicine Practice Guidelines** issued by the Government of India in 2020.
- No financial incentives were offered to patients or physicians for participation.

**Limitations in Methodology**

- Being a cross-sectional study, the analysis was limited to observations made during the study period; long-term outcomes were not assessed.
- Since the sample was selected using convenience sampling, selection bias cannot be ruled out.
- The study relied heavily on **self-reported patient satisfaction**, which may have introduced response bias.
- Telemedicine technology was primarily limited to mobile-based platforms; no institutional EMR-based video consultations were available during the period.

**Innovative Aspects of the Study Design**

- Inclusion of both **patient and doctor perspectives** on telemedicine in orthopaedics.
- Categorization of orthopaedic conditions according to their suitability for remote management.
- Focused examination of **digital literacy and access issues** in rural populations.
- Use of real-time consultations (audio/video) rather than retrospective surveys alone.

**Results**

A total of **250 patients** and **15 orthopaedic doctors** participated in the study. The majority of patients (64%) were from urban areas, while 36% were from rural backgrounds. The mean age of patients was **46.8 years**, with 56.8% being male and 43.2% female.

The most commonly managed orthopaedic conditions through telemedicine were **degenerative joint disorders** (32.8%), followed by **soft tissue injuries** (16.4%) and **fracture follow-up cases** (14.4%). Notably, **11.2%** of patients utilized teleconsultation for post-operative wound checks.

Out of all the consultations, **78.4% were video-based**, while **21.6% were audio-only**. The average duration of a teleconsultation was **12 minutes**.

**Patient Satisfaction**

- **85%** of patients rated their teleconsultation experience as satisfactory or highly satisfactory.
- **82%** found the platform easy to use.
- **72%** felt that the doctor explained their condition clearly.
- **68%** expressed willingness to use telemedicine for future follow-ups.
- **22%** of patients reported technical difficulties, mainly related to poor connectivity.

**Doctor Feedback**

- **73%** of clinicians reported moderate to high confidence in making clinical decisions via teleconsultation.
- **60%** found telemedicine time-efficient.
- However, **40%** expressed concern over inadequate physical examination, especially in trauma cases.
- **67%** of doctors suggested that telemedicine is best suited for follow-up and chronic care, not acute injuries.

A **statistically significant correlation ($p < 0.05$)** was found between patient digital literacy and satisfaction score. Rural patients were more likely to require assistance during the consultation.

## Discussion

The study demonstrates that telemedicine is a feasible and largely effective tool for delivering orthopaedic care, particularly for follow-ups, chronic pain, and rehabilitation support. High satisfaction levels indicate growing acceptance among patients, especially when physical travel is challenging due to distance, cost, or mobility issues.

Despite its advantages, clinicians emphasized limitations in diagnosing acute musculoskeletal injuries or evaluating joint range of motion without a physical exam. The inability to palpate, assess muscle tone, or conduct special orthopaedic tests remotely remains a significant limitation.

The results align with prior studies indicating that **tele-orthopaedics** is best suited for selected clinical scenarios. With advancements in wearable sensors and AI-assisted motion analysis, the future holds promise for expanding the role of telemedicine in musculoskeletal care.

## Conclusion

Telemedicine in orthopaedics is an effective, accessible, and patient-friendly modality for non-emergency cases, post-operative care, and chronic musculoskeletal conditions. While not a replacement for in-person visits, it offers a powerful adjunct for remote care, especially in areas with limited orthopaedic services. Institutional support, digital literacy initiatives, and evidence-based guidelines will be key to its wider adoption and safe integration into standard orthopaedic practice.

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