

Expanding the Scope beyond the Shoulder and Knee: Integrating Elbow, Wrist, and Ankle Arthroscopy into Orthopaedic Training

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Abstract:

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Background: Arthroscopy, traditionally dominated by knee and shoulder procedures, has witnessed a paradigm shift with growing recognition of its utility in smaller joints such as the elbow, wrist, and ankle. These joints, though technically more challenging, are increasingly implicated in sports-related trauma, occupational injuries, and degenerative disorders. Despite this clinical demand, arthroscopy training in India continues to emphasize larger joints, often neglecting the smaller yet critical joints.

Methods: This review aims to evaluate the current educational landscape for small joint arthroscopy in India and propose a roadmap for integrating structured training into orthopaedic curriculum. **Results:** A systematic literature review of international training models, current Indian orthopaedic curriculum frameworks, and published data on training outcomes was conducted. Major gaps identified include absence of structured training modules for elbow, wrist, and ankle arthroscopy, limited infrastructure (such as simulators and cadaveric labs), a scarcity of skilled mentors, and inadequate clinical exposure. **Conclusion:** The review concludes that a significant transformation in orthopaedic training is urgently needed. National Medical Commission (NMC) guidelines must be revised to incorporate structured learning modules, supported by investments in simulation and cadaver-based learning, and mentorship programs. These reforms will ensure Indian orthopaedic surgeons are

equipped to deliver safe and effective care for a broader spectrum of joint pathologies.

Keywords: Elbow arthroscopy, wrist arthroscopy, ankle arthroscopy, orthopaedic training, India, surgical education

Introduction

Arthroscopy has significantly advanced the diagnosis and management of joint pathologies since its development in the early 20th century, revolutionizing orthopaedic care, especially for the knee and shoulder joints ^[1]. These large joints have become the cornerstone of arthroscopic training due to their high prevalence in clinical practice and the relatively accessible learning curve of their arthroscopic procedures. Consequently, they continue to dominate both surgical literature and training curricula globally and in India ^[2,3].

However, there is a growing incidence of complex injuries and degenerative

conditions involving smaller joints such as the elbow, wrist, and ankle ^[4]. These joints are increasingly affected due to sports participation, repetitive occupational strain, and trauma, necessitating proficiency in their arthroscopic management ^[2,3]. Despite this rising demand, postgraduate orthopaedic training in India pays minimal attention to small joint arthroscopy, resulting in limited clinical exposure and skill acquisition (Figure 1) ^[5]. This review seeks to evaluate the existing gaps and propose structured, evidence-based reforms to integrate small joint arthroscopy into mainstream orthopaedic education.

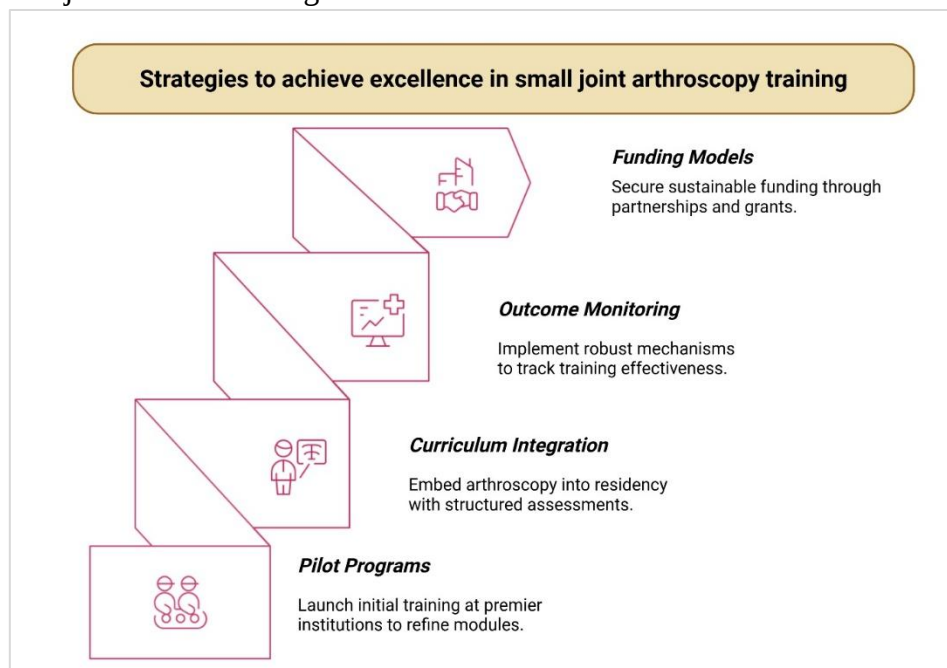


Figure 1: Strategies in small joint arthroscopy training

Current State of Arthroscopy Training in India

Overview of Orthopaedic Residency Programs (NMC Guidelines)

The National Medical Commission (NMC), through its 2023 postgraduate medical education regulations, mandates a three-year orthopaedic residency program designed to cover a broad spectrum of musculoskeletal conditions. The curriculum primarily emphasizes trauma care, deformity correction, and joint

reconstruction procedures. While arthroscopy is acknowledged within the guidelines, its inclusion remains limited, with no formal requirements for exposure to or assessment in arthroscopic techniques, especially for small joints such as the elbow, wrist, and ankle ^[5]. As a result, exposure to arthroscopy in these joints is often unstructured, sporadic, and largely dependent on the interest and expertise of individual faculty members rather than a standardized curriculum ^[5].

Infrastructure and Faculty Limitations

Arthroscopy training in India is largely concentrated in metropolitan and tertiary care centres, with a strong focus on knee and shoulder procedures^[7]. Advanced infrastructure such as dedicated cadaveric dissection labs and arthroscopic simulation platforms—which are critical for developing skills in technically challenging joints like the elbow and wrist—are available only at a few premier institutions^[3,8]. The lack of simulators and dry lab facilities significantly hampers the learning curve for residents and fellows^[9]. Compounding this issue is the shortage of experienced faculty members trained in small joint arthroscopy. This scarcity limits opportunities for trainees to observe and participate in such procedures, resulting in significant gaps in skill acquisition and surgical confidence^[10,11].

Survey and Fellowship Data

An analysis of the ISAKOS fellowship directory reveals that most Indian arthroscopy fellowships continue to focus almost exclusively on the knee and shoulder^[12]. Although select premier institutions such as the All-India Institute of Medical Sciences (AIIMS) and Postgraduate Institute of Medical Education and Research (PGIMER) have started incorporating exposure to elbow, wrist, and ankle arthroscopy into their programs, these efforts are institution-specific and lack integration into a broader national framework. This disparity underscores the urgent need for structured, nationwide policies to promote uniform training opportunities across all orthopaedic training centres in India.

Clinical Importance of Small Joint Arthroscopy

a) Elbow Arthroscopy: Elbow arthroscopy has become an essential tool for managing a variety of conditions affecting this complex joint^[13]. Indications commonly include removal of loose bodies, synovectomy for chronic synovitis, treatment of osteoarthritis, and addressing instability

issues^[14,15]. Due to the intricate anatomy of the elbow, which is surrounded by critical neurovascular structures, the procedure requires a high degree of technical skill and familiarity with arthroscopic portals^[10]. The close proximity of the ulnar nerve, median nerve, and brachial artery means that any misplacement of instruments can result in serious complications, including permanent nerve injury^[16]. Therefore, comprehensive training and a detailed understanding of elbow anatomy are vital before surgeons attempt elbow arthroscopy independently. Despite these challenges, arthroscopic intervention offers advantages over open surgery, such as reduced soft tissue trauma and faster recovery times, making it a preferred approach in experienced hands^[10,16].

b) Wrist Arthroscopy: Wrist arthroscopy has gained prominence as both a diagnostic and therapeutic modality, particularly for conditions involving the triangular fibrocartilage complex (TFCC), scapholunate ligament injuries, and various forms of carpal instability^[17]. Its minimally invasive nature allows direct visualization of intra-articular structures, facilitating accurate diagnosis that often cannot be achieved with imaging alone^[3]. Therapeutically, wrist arthroscopy enables procedures such as debridement, ligament repair, and synovectomy with minimal disruption to the surrounding tissues^[18]. Given the wrist's small joint space and complex ligamentous anatomy, specialized training is essential to ensure safe portal placement and effective instrument handling^[19]. Mastery of wrist arthroscopy contributes significantly to improved patient outcomes, reducing the need for open surgery and promoting quicker functional recovery^[3,18].

c) Ankle Arthroscopy: Ankle arthroscopy addresses a spectrum of

pathologies, including anterior ankle impingement, osteochondral lesions of the talus, and removal of loose bodies resulting from trauma or degenerative changes ^[20]. With the rise in athletic activities and related injuries, the demand for skilled ankle arthroscopists is steadily increasing ^[2]. The ankle joint, being relatively superficial but constrained by tight soft tissues, presents unique challenges that require specific training and experience. Arthroscopic management offers benefits such as smaller incisions, less postoperative pain, and earlier return to activity compared to open procedures ^[2].

Outcomes and Global Best Practices

Globally, evidence supports that arthroscopy of the elbow, wrist, and ankle, when performed by well-trained surgeons, yield superior functional outcomes, reduced complication rates, and faster rehabilitation compared to traditional open surgeries ^[11,16,18]. Countries with advanced arthroscopy training programs, such as the United States and Germany, emphasize the integration of structured, simulation-based education and hands-on cadaveric practice to prepare residents and fellows for these complex procedures ^[2,21]. This approach has been shown to improve technical competence and confidence before live surgery, minimizing risks and enhancing patient safety. Adopting such best practices in training is essential to meet the growing clinical demand for small joint arthroscopy in India and elsewhere.

Educational and Training Challenges

A major obstacle in advancing small joint arthroscopy training in India is the **absence of structured educational modules** within most orthopaedic residency programs ^[22]. Despite the growing clinical need for expertise in elbow, wrist, and ankle arthroscopy, these procedures often receive minimal or incidental attention in training curricula. This lack of formalized instruction leads to inconsistent exposure among trainees,

leaving many inadequately prepared to independently perform small joint arthroscopies upon graduation ^[3,5]. The deficiency of standardized guidelines and competency benchmarks prevents systematic skill acquisition, resulting in variable proficiency levels across training centres.

Compounding the issue are serious **infrastructural limitations** ^[7]. Only a select number of premier institutions possess cadaveric dissection facilities and high-fidelity arthroscopic simulators crucial for safe, hands-on practice with technically demanding small joint procedures. Most government hospitals, which cater to a majority of trainees, often lack these resources including arthroscopic towers and simulation labs ^[8,11]. Without access to such essential infrastructure, residents are deprived of the opportunity for repetitive practice and safe skill refinement, which are key to mastering complex arthroscopy techniques.

Another critical barrier is the shortage of **faculty skilled in small joint arthroscopy**. Few orthopaedic surgeons in India have adequate experience or training in these procedures to serve as mentors. This faculty gap limits supervised case exposure, depriving trainees of valuable real-time guidance, feedback, and case-based learning necessary for developing surgical confidence and competence ^[10,11]. Additionally, the absence of formal “train the trainer” programs further restrict faculty skill enhancement and propagation. Lastly, there is a marked disparity in **case volume and clinical exposure**. Government hospitals, overwhelmed with trauma and emergency cases, typically perform fewer elective small joint arthroscopies, thereby limiting residents’ operative opportunities. Conversely, private institutions, which often handle more elective cases, remain less accessible for many trainees, creating inequities in hands-on experience ^[6,12]. Overcoming these multifaceted challenges through curriculum reform, infrastructure

development, faculty training, and equitable case distribution is vital to produce competent surgeons skilled in small joint arthroscopy.

Global Educational Models

Across the globe, recognition of the complexity and importance of small joint arthroscopy has led to the development of advanced, structured training programs designed to overcome educational gaps and improve surgical proficiency. Many countries have adopted comprehensive fellowship programs and incorporated simulation-based education to ensure that trainees gain the necessary skills and confidence to perform these technically demanding procedures safely and effectively^[23].

In the United States, arthroscopic training has evolved to include the use of **high-fidelity simulation platforms** that closely mimic real surgical environments^[24]. These simulators allow residents and fellows to practice intricate manoeuvres repeatedly in a risk-free setting, enhancing hand-eye coordination and familiarity with arthroscopic equipment^[2,21]. Additionally, U.S. training programs utilize **structured milestone-based evaluations** to systematically assess residents' progress at various stages^[25]. This competency-based approach ensures that learners achieve defined technical and cognitive skills before advancing, fostering a standardized and objective method for skill acquisition^[2,21].

European countries such as Germany have placed strong emphasis on **cadaveric dissection labs**, recognizing their value in providing hands-on anatomical understanding and realistic surgical practice^[26]. Coupled with these labs, supervised fellowship programs enable trainees to work closely with experienced surgeons, refining their techniques under expert guidance^[12]. This mentorship model not only hones technical skills but also imparts decision-making capabilities crucial for managing intraoperative challenges^[27]. Similarly, Japan prioritizes

intensive hands-on fellowships combined with anatomical study, creating a robust framework for small joint arthroscopy training^[12].

International bodies like the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) have further contributed by curating a **directory of fellowship opportunities** worldwide, with a growing focus on small joint arthroscopy^[12]. This resource serves as a valuable reference for trainees seeking specialized training abroad and offers a blueprint for emerging programs in countries like India.

Adopting and adapting these global models—simulation integration, cadaveric labs, structured evaluations, and mentorship fellowships—can significantly elevate the quality and consistency of small joint arthroscopy training in India, bridging current gaps and aligning with international best practices.

Recommendations for the Indian Scenario

The pressing need to integrate small joint arthroscopy into the Indian orthopaedic training framework calls for a comprehensive, multi-pronged strategy. Drawing from global best practices and addressing the unique challenges within India's healthcare ecosystem, the following recommendations provide a pragmatic roadmap to transform orthopaedic education and ultimately enhance patient care outcomes.

Curriculum Restructuring

A fundamental step toward advancing small joint arthroscopy training is the formal inclusion of dedicated modules within the postgraduate orthopaedic curriculum. The National Medical Commission (NMC) should revise existing guidelines to mandate structured learning units specifically focused on elbow, wrist, and ankle arthroscopy. These modules must encompass core components such as diagnostic arthroscopy techniques, portal placement strategies, management of intraoperative complications, and

postoperative care protocols. By embedding these elements in MS (Master of Surgery), DNB (Diplomate of National Board), and diploma programs, a standardized baseline competency can be assured nationwide^[2,5].

To objectively measure surgical proficiency, assessment methods like the Objective Structured Assessment of Technical Skill (OSATS) should be systematically implemented. OSATS offers a validated framework for evaluating both technical execution and decision-making during arthroscopic procedures, providing actionable feedback that drives continuous improvement^[2,5]. Incorporating OSATS into exit examinations and periodic evaluations would foster accountability and incentivize skill development in small joint arthroscopy.

Fellowship and Short-term Training Programs

Beyond formal residency training, expanding fellowship opportunities

focused on small joint arthroscopy is critical^[28]. Certified short-term courses, workshops, and observer ship programs designed in collaboration with the Indian Orthopaedic Association (IOA), International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS), and regional orthopaedic societies can play a pivotal role in bridging existing knowledge gaps^[6,12,29]. These programs should emphasize hands-on exposure through live surgical demonstrations, cadaveric practice, and case-based discussions, thereby boosting learner confidence and clinical decision-making skills.

Such targeted training opportunities must be made widely accessible, particularly for surgeons practicing in non-metropolitan areas, to democratize skill acquisition and improve nationwide surgical standards (Figure 2). Encouraging cross-institutional partnerships can facilitate the exchange of expertise and resources, enhancing program quality and reach.



Figure 2: Target oriented structured training program strategies for small joint arthroscopy

Simulation-Based and Cadaveric Training

The integration of simulation-based education represents a powerful adjunct to traditional training methods. Evidence robustly supports the role of arthroscopy

simulators in accelerating early skill acquisition, improving hand-eye coordination, and reducing intraoperative errors—especially for complex small joint procedures^[11,21,30]. Simulation allows trainees to practice repeatedly in a risk-

free environment, leading to improved surgical confidence and competence.

Establishing dedicated dry and wet laboratories equipped with high-fidelity simulators and cadaveric specimens should be a priority for medical colleges and training centres. Public-private partnerships involving government bodies, academic institutions, and medical device companies can provide the necessary financial and technical support to develop these centres^[8,11]. This collaborative model can ensure sustainable infrastructure development while optimizing resource utilization.

Mentor Development and Faculty Training

A cornerstone of any successful educational reform is the presence of skilled and motivated faculty mentors. To address the current shortage of experienced small joint arthroscopy trainers, a “Train the Trainers” initiative should be launched at a national level. This program would identify promising orthopaedic surgeons and equip them with advanced teaching skills, arthroscopic expertise, and mentorship techniques^[2,29]. Faculty members should be actively encouraged and supported to attend international workshops, online courses, and hands-on training abroad to update and refine their competencies. Creating a national registry of trained mentors can facilitate peer support networks and continuous professional development. Recognizing and incentivizing faculty contributions through academic promotions and awards will further strengthen the mentorship culture.

By implementing these strategically aligned recommendations, India can revolutionize its orthopaedic training paradigm, ensuring that future surgeons are proficient in small joint arthroscopy and capable of delivering world-class care. This holistic approach promises to bridge existing gaps, standardize education, and promote surgical excellence across the country.

Practical Roadmap for Implementation

The successful integration of small joint arthroscopy into orthopaedic training in India requires a pragmatic, phased approach tailored to existing institutional capacities and resource availability. The following roadmap outlines actionable steps to facilitate this transformation.

Pilot Programs

To initiate the process, pilot training programs should be launched at premier institutions renowned for orthopaedic excellence, such as All India Institute of Medical Sciences (AIIMS), Postgraduate Institute of Medical Education and Research (PGI) Chandigarh, and Christian Medical College (CMC) Vellore. These centres possess the foundational infrastructure and faculty expertise necessary to design, execute, and refine small joint arthroscopy modules. Outcomes and feedback from these pilots can guide wider adoption and scalability, ensuring a contextualized approach aligned with India’s diverse healthcare landscape^[2,6].

Curriculum Integration

A critical step involves embedding small joint arthroscopy into the residency curriculum as a formal component. Final-year electives focusing on elbow, wrist, and ankle arthroscopy can provide concentrated exposure under expert supervision. Furthermore, incorporating structured assessments such as the Objective Structured Assessment of Technical Skill (OSATS) will ensure standardized evaluation of surgical proficiency and complication management. This systematic integration will promote consistent skill acquisition and instil confidence among trainees before they enter independent practice^[2,5].

Outcome Monitoring

Robust mechanisms for monitoring training outcomes are essential to validate program effectiveness and identify areas for improvement. Maintaining detailed surgical skill logs, conducting regular complication audits, and collecting patient-

reported outcome measures (PROMs) will offer comprehensive insights into both trainee performance and patient satisfaction^[31]. These data points can be used to continuously refine educational strategies and reinforce quality assurance in small joint arthroscopy training^[2,16].

Funding Models

Sustainable funding is paramount for infrastructure development, faculty training, and procurement of simulation equipment. Potential sources include government health departments that prioritize skill enhancement initiatives, corporate social responsibility (CSR) contributions from medical device manufacturers, and grants from international educational bodies committed to capacity building. Establishing transparent funding channels and fostering multi-sector partnerships will ensure long-term viability of these training programs^[2,16]. This structured roadmap, grounded in evidence and pragmatic considerations, provides a clear path forward for elevating small joint arthroscopy training standards across India's orthopaedic community.

Conclusion

Small joint arthroscopy, once overshadowed by knee and shoulder procedures, is now essential in orthopaedics, particularly for managing trauma, sports injuries, and degenerative conditions of the elbow, wrist, and ankle. However, India's training system remains heavily focused on larger joints, creating a gap between evolving clinical demands and surgical expertise. To bridge this divide, curriculum reform, infrastructure enhancement, and faculty development are crucial. Incorporating small joint arthroscopy into residency guidelines, alongside competency assessments like OSATS, will standardize training. Simulation-based learning, cadaveric dissections, and fellowships will refine skills in a risk-free environment. A strong mentorship framework, reinforced by "Train the Trainers" programs, can ensure

sustained knowledge transfer. Pilot programs at leading institutions, backed by outcome monitoring and funding partnerships, will drive systematic change. These reforms can elevate surgical education and patient care, positioning India as a global leader in comprehensive arthroscopic expertise.

Conflict of interest

None declared any conflict of interest

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