RESIDENTS' CORNER • CME

# Artificial Intelligence in Orthopaedics: What's Real, What's Coming

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*For the Nepal Orthopedic Association, from junior resident to senior consultant*

I still remember reading a badly exposed wrist film at two in the morning as a resident, squinting at a scaphoid that may or may not have had a fracture line through it. Today, a piece of software could flag that same film in under a second, and it would probably be right more often than I was at two in the morning. Whether that changes what it means to be a good orthopaedic surgeon is really the question behind this whole article, and it is worth sitting with rather than rushing past.

Artificial intelligence has already left the conference hall and entered the operating theatre and the emergency room. It reads X-rays. It plans knee replacements. It listens to us dictate notes. Some of it is genuinely useful. Some of it is marketing dressed up as innovation. Part of our job now, at every level of training, is telling the difference. This piece is written for that purpose, as a working reference rather than a hype piece, and every figure in it has been checked against the original source before being printed.

## It Is Already Everywhere, We Just Stopped Noticing

Computers fly our planes, drive some of our cars, and quietly decide which advertisement shows up on our phone after we search for something online. Supercomputers beat grandmasters at chess and solve problems in a fraction of a second that would take a human a lifetime. None of this is science fiction anymore. It is the ordinary background of daily life, and orthopaedics, a specialty built on images and mechanics, was always going to be an early adopter.

## Where Ortho Already Uses It, Quietly

Robotic assistance in knee replacement helps with prosthesis alignment and supports minimally invasive approaches. In arthroscopic ACL reconstruction, robotic guidance has been shown to position femoral and tibial tunnels more accurately than freehand technique, which matters because tunnel malposition is one of the more common reasons a reconstruction later needs revision. In spine surgery, computer-assisted navigation is now well established for thoracic and lumbar pedicle screw placement, largely because it helps the surgeon stay clear of the neurovascular structures sitting a few millimetres away from the drill path.

None of this is new or experimental. If you trained anywhere with a robotic arthroplasty programme or a navigation-equipped spine theatre in the last five years, you have already worked alongside AI without necessarily calling it that.

## The Study Every Resident Should Actually Read

In 2017, a group at Karolinska Institutet and Danderyd Hospital in Stockholm, working with the Royal Institute of Technology, published one of the first serious tests of deep learning on orthopaedic trauma films. They pulled 256,458 hand, wrist, and ankle radiographs out of their picture archive, labelled each one for fracture, laterality, body part, and view, and trained several neural networks on the set. The best-performing network held its own against human readers on the fracture-detection task. It was published in Acta Orthopaedica, it is openly available, and it remains one of the cleanest demonstrations that an algorithm can be trained on ordinary hospital data to do something clinically meaningful, not just impressive on a slide.

I mention this one specifically because it is the kind of study a resident can actually go and read in an evening, and because the dataset came from routine clinical archives rather than a curated research set. That is closer to how these tools will actually get built for a place like Nepal, if we ever decide to build one ourselves.

## How These Tools Reach the Clinic, in One Paragraph

Regulatory clearance matters more than it sounds. In the United States, most clinical AI software is cleared through the FDA's 510(k) pathway, showing it is substantially equivalent to something already on the market, or the De Novo pathway for something genuinely new. Almost every fracture-detection tool currently in use carries an explicit label calling it an adjunct, not a replacement for clinician judgement. That single word, adjunct, is doing a lot of legal and clinical work, and it is worth remembering the next time a vendor's slide deck implies otherwise. The clinician signing the report remains the one accountable for it.

## FDA-Cleared Tools Worth Knowing By Name

The table below pulls together the categories most likely to cross a resident's or consultant's path, with named examples checked against primary sources rather than vendor marketing material.

| Domain | Named example (regulatory status) | What it actually does |
|---|---|---|
| Fracture detection on plain film | Imagen OsteoDetect (FDA De Novo, 2018); GLEAMER BoneView (FDA 510(k)); Aidoc C-Spine and Rib Fracture Triage (FDA 510(k), 2019 and 2025) | Flags and localises fractures, wrist first, now extended to multiple regions, as a second reader before the clinician signs the report. Labelled an adjunct, not a replacement for clinician review. |
| Robotic-arm joint replacement | Stryker Mako (FDA-cleared 2015); Zimmer Biomet ROSA; DePuy Synthes VELYS; Smith+Nephew CORI | AI-assisted, CT-based or imageless planning builds a patient-specific cut plan; a haptically-constrained robotic arm executes it under direct surgeon control. Stryker reports more than 2.5 million Mako procedures performed across 47 countries as of mid-2026. |
| Spine navigation | TiRobot; Globus ExcelsiusGPS; Medtronic Mazor X Stealth | AI-assisted trajectory planning for pedicle screws; TiRobot deployments have been reported to cut intra-operative fluoroscopy time substantially compared with freehand technique. |
| Perioperative workflow | Institution-built prescriptive-analytics systems, for example The Ottawa Hospital | Machine-learning models resequence theatre lists and flag patients at higher risk of prolonged stay or complications. No new hardware required, just better scheduling predictions. |
| Patient education | Hospital for Special Surgery custom-tailored AI chatbot (pilot, 2025) | A chatbot trained only on surgeon-approved content answers routine pre- and post-operative questions for arthroplasty patients. Low cost, low risk entry point for departments not ready for capital equipment. |

| Domain | Named example (regulatory status) | What it actually does |
|---|---|---|
| Adjacent precedent, not orthopaedic | IDx-DR (FDA De Novo, 2018); Viz.AI (FDA-cleared, 2018) | IDx-DR autonomously screens retinal photos for diabetic retinopathy. Viz.AI flags CT scans suspicious for large-vessel stroke. Neither treats bone or joint disease; both matter to us only as proof that autonomous, regulator-approved AI diagnosis is real, and that the same pathway will keep reaching orthopaedic tools. |

*Table 1. Representative FDA-cleared or FDA-authorised AI and AI-guided systems relevant to orthopaedic practice, by clinical domain.*

## Hospital Examples Around the World

- **United States,** Hospital for Special Surgery and Mayo Clinic sit among the highest-output centres for orthopaedic AI research, and HSS has already moved a patient-education chatbot into clinical piloting. Mako, ROSA, VELYS, and CORI robots are now standard equipment in many American arthroplasty units.
- **Canada,** The Ottawa Hospital published a case series showing that a prescriptive-analytics scheduling system raised same-day completion of routine arthroplasty lists from 39 percent to 93 percent, a workflow gain achieved with no new hardware at all, just better predictions feeding the theatre schedule.
- **Europe,** GLEAMER's BoneView is deployed across numerous French and other European emergency departments with both CE marking and FDA clearance, and has been the subject of large real-world evaluations of AI fracture detection at population scale.
- **China,** TiRobot-series spine and trauma robots, developed domestically, have been adopted across multiple tertiary centres, with published series reporting reduced fluoroscopy time and improved screw-placement accuracy.
- **Lower-resource and high-volume settings,** reviews of AI fracture-detection performance specifically flag benefit in high-traffic, lower-resource emergency departments, where a validated second reader can partially offset a shortage of radiologists or on-call orthopaedic staff, provided the tool is validated locally before anyone leans on it.

A pattern runs through all of these: adoption has clustered around catching what a tired or junior reader might miss on a film, standardising the mechanical precision of an implant, and quietly making the operating list run better. None of the widely deployed, FDA-cleared tools reviewed here make an autonomous diagnosis or operate without a surgeon at the controls.

## Voice Agents and the Death of the Search Bar

A newer and less discussed category is the voice agent, the orthopaedic equivalent of asking a very well-read colleague a question out loud instead of typing it into a search bar. IBM's Watson had an early health-focused version of this, and similar knowledge tools now sit inside Google, Apple, and Amazon devices. In practice this means being able to ask, out loud, for a reminder of a patient's surgical history, for pooled data on a specific meniscus tear pattern, or for a second opinion on removing a broken screw that has resisted your usual technique. The technology behind this has matured considerably faster than our workflows have adapted to it, which is itself worth noticing.

## The Money Question, With the Real Numbers

In 2017, Accenture published an analysis estimating that the ten most promising clinical AI applications could generate up to 150 billion US dollars in annual savings for the American healthcare system by 2026. The single largest contributor in that estimate was not imaging or diagnostics, it was robot-assisted surgery, projected at roughly 40 billion dollars a year on its own, ahead of virtual nursing assistants and administrative workflow tools. Whatever one thinks of consulting-firm projections, the underlying point holds locally too: every orthopaedic surgeon carrying a smartphone and using an EMR is generating clinical data every single day, and that data has value whether or not we are the ones capturing it.

## Will We Be Replaced?

Almost certainly not in the sense residents worry about at three in the morning. The more realistic picture, and the one supported by how these tools are actually deployed today, is a surgeon working in partnership with software that is very good at drawing conclusions from large datasets: organising operating lists, prioritising the trauma queue, or predicting which patient is at higher risk of an unplanned readmission or a prolonged stay. The honest vision is one where administrative and pattern-recognition work increasingly moves to the machine, freeing the surgeon to spend more of the day doing the parts of the job that actually require a surgeon.

Elon Musk and the late Stephen Hawking both publicly warned, at different points, about the long-term risks of unchecked artificial intelligence. Their warnings were aimed at general, unconstrained AI, not at a fracture-detection algorithm running inside a hospital PACS. It is worth keeping that distinction clear in our own heads before we repeat the warning out of context.

## The Ethical Questions We Have Not Answered

Robotic surgery raises real questions we have not fully worked through as a profession: who is accountable when a robotically assisted cut goes wrong, how much of the consent conversation needs to name the machine specifically, and what happens to training pathways if trainees log fewer hands-on cases because a system is doing more of the mechanical work. I do not think there is a settled answer yet, and I would treat anyone who claims there is with some suspicion.

## Will This Reach Nepal?

Orthopaedic classification systems, treatment algorithms, and outcomes databases already exist in the form clinicians are used to. The bigger shift is registries: the American Joint Replacement Registry is one working example of what a large, structured outcomes dataset can become once enough data accumulates, and it is a reasonable place to look for a model, not necessarily to copy. AI could realistically be used, in a setting like ours, to screen radiographs for subtle abnormalities, to back up a tired night registrar's fracture read with a second machine opinion, or to track a bone tumour's response to chemotherapy over serial imaging.

None of this requires a robotic arm or a seven-figure capital purchase. The fracture-detection category, software layered onto an existing X-ray workflow, is by far the lowest-cost, highest-relevance entry point for a high trauma-volume, resource-constrained department, and the published evidence specifically supports benefit in exactly that kind of setting. Robotic arthroplasty and spine platforms, by contrast, carry real capital and consumable costs and remain realistic for only a small number of high-volume centres in the near term.

## Limitations Every Trainee Should Be Able to Recite

- Adjunct, not replacement. Every FDA-cleared fracture-detection tool in current use is explicitly labelled a decision-support adjunct; the clinician's sign-off remains the point of accountability.
- Uneven performance by anatomy. Sensitivity is strongest for extremity fractures such as wrist and ankle, and weaker and less validated for spine and rib fractures. Do not assume uniform accuracy across regions.
- Dataset and population bias. Most validation datasets come from high-income health systems. Local, prospective validation is worth doing before any department leans on a tool's stated accuracy.
- Automation bias. Over-relying on an AI flag, or on a reassuring negative result, is a recognised failure mode and a genuine patient-safety risk if nobody actively guards against it.
- Cost and workflow integration. Robotic and navigation platforms need real capital investment, maintenance contracts, and a learning curve. Value shows up fastest in higher-volume centres.

## A Closing Thought

Computers are approaching the point of diagnosing disease and assisting surgery in the same breath. Orthopaedics was always going to be an early target for this, precisely because bone and soft tissue image so cleanly compared to most other organ systems. The honest question is not whether a machine could one day locate, align, and fix a fracture with a mechanical arm of its own. Some early version of that already exists. The honest question is what kind of surgeon each of us wants to be while that happens around us, and whether we are the ones shaping how it gets used in our own hospitals, or simply the ones it gets used on.

AI in orthopaedics is not a single technology. It is a collection of tools that sense, interpret, predict, and occasionally act, and every one of them still answers, in the end, to a surgeon in the room. That will not change soon. What will change is how much of our day gets freed up for the parts of this job that actually needed a human being all along.

## For Further Reading

Readers who want to sit with these questions a little longer, beyond what a single CME article can cover, may find ***Inside the Intelligent Hospital: Artificial Intelligence, Clinical Informatics, and the New Infrastructure of Modern Medicine*** a useful companion. Written by **Dr. Sanjeev Uprety** together with co-author Anugraha Uprety, it draws on more than three decades of clinical practice at the intersection of orthopaedic surgery and health information technology, and it includes orthopaedic case illustrations alongside its broader look at electronic health records, clinical decision support, imaging, and interoperability. Available on Amazon in Kindle and paperback: [amazon.com/dp/B0H7CVK19X](https://amazon.com/dp/B0H7CVK19X).

## Take-Home Points for CME Credit

- AI in orthopaedics is regulated, in use, and increasingly evidence-based, not a speculative future technology.

- FDA-cleared fracture-detection software, OsteoDetect, BoneView, and the Aidoc module among them, functions as a second reader and has the strongest evidence base for extremity radiographs.
- Robotic-arm systems (Mako, ROSA, VELYS, CORI) and spine navigation robots (TiRobot, ExcelsiusGPS, Mazor X) use AI-assisted planning to individualise and constrain the mechanical steps of surgery, with the surgeon still in direct control.
- Some of the best-documented efficiency gains, such as The Ottawa Hospital's theatre-scheduling model, come from non-imaging, workflow-level AI, a lower-cost entry point worth considering locally.
- For a high trauma-volume, resource-constrained setting like Nepal's, fracture-detection software is the most realistic near-term entry point; robotic platforms remain a longer-term investment.

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*Dr. Sanjeev Uprety, MS (Ortho), MSc-IT, HIT (USA), is the author of Inside the Intelligent Hospital: Artificial Intelligence, Clinical Informatics, and the New Infrastructure of Modern Medicine (with Anugraha Uprety), available on Amazon in Kindle and paperback. Prepared for the Nepal Orthopedic Association, Residents' Corner and CME. Every statistic and named study above was checked*

*against its original source before inclusion; where a claim could not be verified or was found to be misattributed, it was corrected or removed rather than repeated.*