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Preserving the native joint stage IV femoral head avascular necrosis in a young woman treated with joint-salvage core decompression, fibular grafting, and Ilizarov articulated hinge distraction

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Introduction

Avascular necrosis (AVN) of the femoral head begins, at its core, with a loss of blood supply to the bone. Whatever the trigger - trauma, a clotting disorder, long-term steroid use, a haemoglobinopathy, or no identifiable cause at all - the effect on the femoral head is the same: the subchondral bone is starved of oxygen and begins to die. Left unchecked, the dead trabecular bone and the cartilage sitting above it can no longer bear load, and the once-round femoral head gradually flattens, fragments, and stops fitting the acetabulum the way it should.[1,2]

Most of what has been published on advanced AVN concerns older patients who already carry an obvious risk factor. A 20-year-old woman with no medical history, no steroid exposure, no trauma, and bilateral disease does not fit that picture, and she raises a very different set of questions. Total hip arthroplasty (THA) would certainly relieve her pain, but it is not a durable answer for someone with sixty-plus years ahead of her - implants wear, bone stock erodes with every revision, and a young patient who receives a hip replacement today is signing up for a lifetime of further surgery. Every extra year she can keep her own joint is worth fighting for.[2,3]

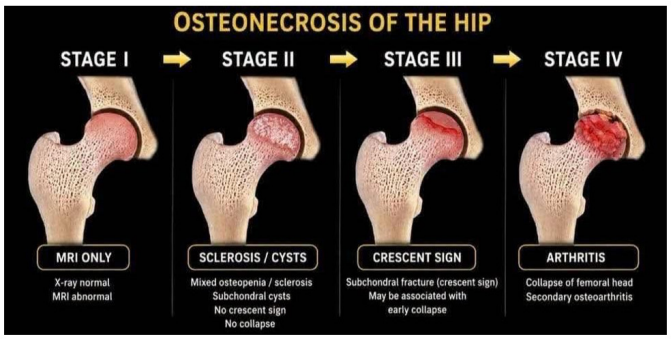

Figure 1 Ficat–Arlet staging of osteonecrosis of the hip.

We still use the Ficat–Arlet system to stage this disease. Stage IV is the end of the road radiographically: the femoral head has flattened, the joint space has narrowed, and secondary arthritic change has crept into the acetabulum. [3,4] Faced with a Stage IV joint, many surgeons simply move to arthroplasty on the assumption that preservation is no longer possible. We do not think that assumption should go unexamined in a young patient - joint salvage deserves a real look before a 20-year-old is committed to decades of prosthetic surveillance.

Our approach layered three separate mechanisms on top of one another, each addressing a different part of the problem:

- Core decompression - to bring down the abnormally high pressure inside the bone and let blood flow return.[5]
- Fibular strut grafting - to prop up the collapsed subchondral bone mechanically and give the area a scaffold for new bone to grow along.[5,6]
- Ilizarov Articulated Hinge Distraction (Ligamentotaxis) - to take the joint surfaces out of contact altogether, creating conditions in which fibrocartilage can form.[7,8]

None of these three does the whole job alone; together, they attack the mechanical and biological sides of the problem at once. What follows is the story of how this combination was used to rescue the hip joint of a young woman whose disease had already reached its most advanced stage.

Case presentation

Patient profile and history

Our patient was an unmarried, otherwise healthy 20-year-old woman. She had never taken corticosteroids, did not drink or smoke, had no history of sickle cell disease or a connective-tissue disorder, and had suffered no trauma to either hip. Nothing in her family history pointed to a musculoskeletal or blood disorder either - by every conventional measure, she should not have developed this disease, let alone on both sides.

Her symptoms had started quietly, two years before as a dull ache in both groins that she initially put down to overuse. Over the following months it worsened steadily: the pain spread toward both greater trochanters, began waking her at night, and forced her into a guarded, favoring gait. Eventually she needed a walking aid, and ordinary tasks - climbing stairs, standing up from a low chair - became difficult or impossible.[2,9]

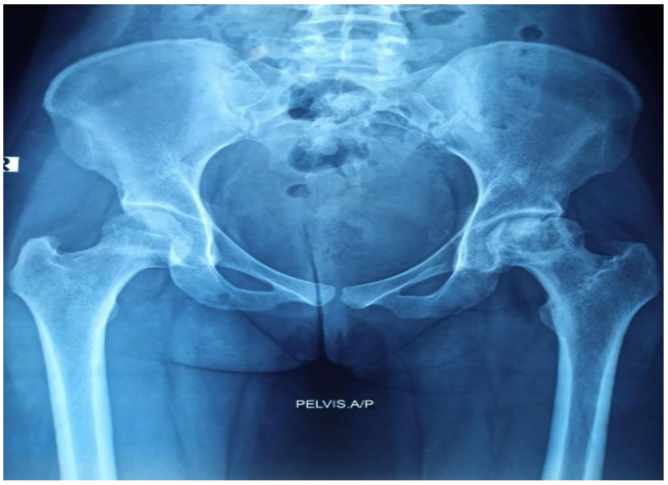

Figure 2 AP pelvis radiograph showing Stage 2 disease on the right and Stage 4 disease on the left.

Physical examination

On examination she walked with an obvious bilateral antalgic gait, shifting her weight off both hips as she moved. Both groins and trochanters were tender to palpation, and hip range of motion was markedly restricted in every plane - internal rotation was the worst affected, under 10 degrees on each side. A positive Thomas test confirmed fixed flexion contractures on both hips. Her legs were equal in length and a full neurovascular examination of both lower limbs was unremarkable.[10,11]

Diagnostic workup

We screened her thoroughly for a secondary cause of osteonecrosis. Every test came back normal, which - while frustrating from a diagnostic standpoint - at least ruled out the usual suspects:

Investigation	Finding
Full Blood Count (FBC)	Normal; no anaemia and no elevation of white cells or platelets
Erythrocyte Sedimentation Rate (ESR)	Within normal limits
C-Reactive Protein (CRP)	Negative (< 5 mg/L)
Serum Calcium & Phosphorus	Normal
Alkaline Phosphatase (ALP)	Normal
Serum Uric Acid	Within normal range
Rheumatoid Factor (RF) / ANA	Negative
Lipid Profile	Normal; no dyslipidaemia
Haemoglobin Electrophoresis	Normal; sickle cell disease and related haemoglobinopathies excluded
Coagulation Screen	Normal; no hypercoagulable state identified
Plain Radiography (AP Pelvis)	Marked bilateral flattening and collapse of the femoral heads, joint-space narrowing, subchondral sclerosis and peripheral osteophytes, in keeping with Ficat–Arlet Stage IV changes on the left, stage II on right side.
MRI	Extensive subchondral bone-marrow oedema on the left, complete collapse of the superior weight-bearing zone, moderate joint effusion, and early degenerative signal change in both acetabular cartilage surfaces

Failure of conservative treatment

Before she reached us, she had already spent a year on conservative treatment elsewhere: oral ibandronic acid, regular analgesics, physiotherapy, and instructions to avoid weight-bearing.[12]

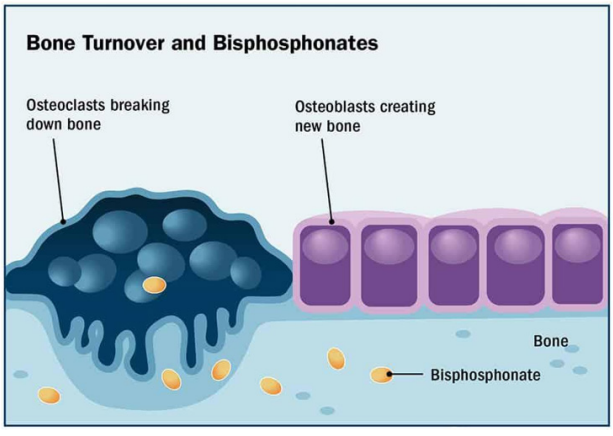

Figure 3 How bisphosphonates such as ibandronic acid act on bone turnover.

Bisphosphonates can, in principle, slow osteoclastic resorption and protect the trabecular scaffold - but only if given before collapse occurs. By the time she started treatment, her femoral heads had already collapsed, so the drug had nothing left to protect. Radiographs taken during that year showed the flattening getting steadily worse, with no let-up in her pain or function. Non-operative treatment had, in effect, already failed by the time she came to us.[12,13]

Surgical management

Rationale and decision-making

This was a genuinely difficult decision. We were looking at a 20-year-old with no systemic illness, advanced bilateral disease (Stage 4 on the left, Stage 2 on the right) - exactly the picture that most guidelines would send straight to total hip replacement. But a prosthesis placed at age 20 is, realistically, a guarantee of at least one revision, and probably more, with bone stock and options shrinking each time. If native-joint salvage had any realistic chance of working, even partially or for a limited number of years, it was worth trying first.[6,14]

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After a detailed discussion in which she was made fully aware that this combined biological approach was still experimental compared with arthroplasty, she gave informed written consent, and we proceeded with a staged procedure on the left hip: core decompression, autologous fibular strut grafting, and immediate application of an articulated Ilizarov frame.[11]

Operative technique

Surgery was performed under spinal anesthesia with the patient supine on a radiolucent traction table, using a standard anterolateral approach to the proximal femur.

i. Core decompression: performed first, under C-arm guidance. A cannulated drill was used to create several tracks running from the lateral cortex of the proximal femur, through the neck, and into the center of the necrotic segment - releasing the raised intraosseous pressure and opening channels for vascular and cellular ingrowth.[14]

ii. Fibular strut grafting: a segment of cortical fibula was harvested from the same leg through a separate incision, shaped, and impacted retrogradely up the decompression track to sit firmly beneath the collapsed subchondral bone - providing a mechanical column against further collapse and a scaffold for revascularisation.[11]

iii. Ilizarov frame: applied in the same sitting once the wounds were closed. The construct included an articulated hinge centred on the hip's axis of rotation, allowing flexion and extension while maintaining controlled distraction. We chose this deliberately over a static frame, since we wanted the joint to keep moving through the recovery period rather than sit locked for months.[7,8]

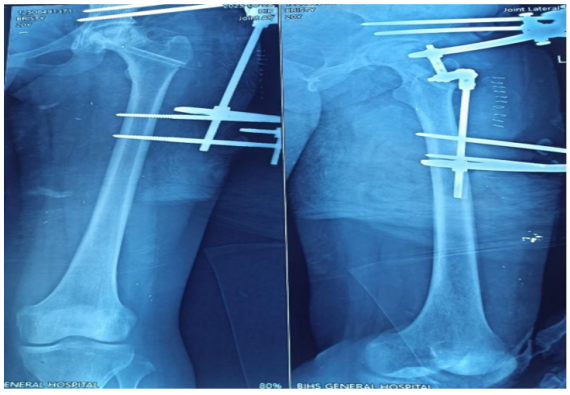

Figure 4 Radiographs after core decompression, fibular grafting, and application of the Ilizarov frame for distraction.

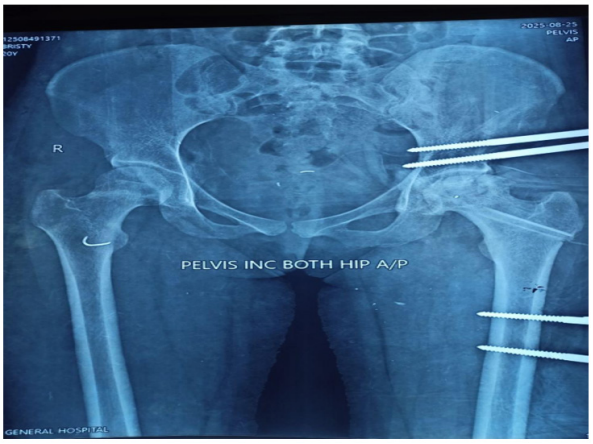

Figure 5 Close-up view of the hip joint following frame application.

Postoperative distraction protocol

Distraction began on postoperative day 3. Starting earlier risks wound breakdown; waiting longer allows periarticular scarring to set in and makes distraction far more painful. By day 3 her wounds were stable and her pain well controlled, so we proceeded for gradual distraction.

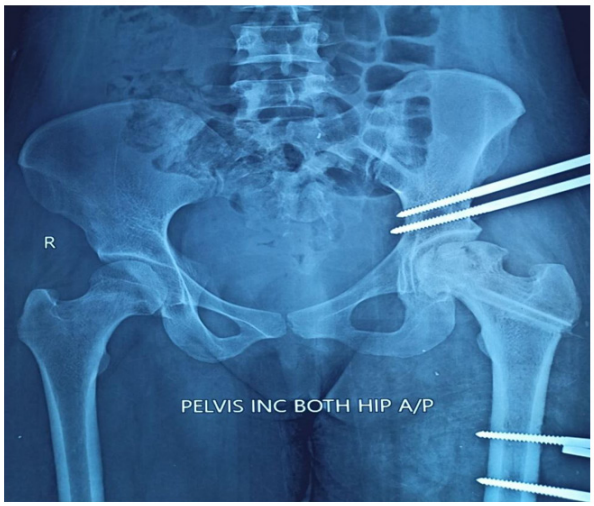

Figure 6 Gradual distraction of the hip joint beginning on postoperative day 3.

We distracted at 1 mm per day, in small steps, over ten days, for a total gap of 8–10 mm. Pulling the joint surfaces apart like this takes away the compressive load that had been grinding down the damaged cartilage, and creates a low-pressure, fluid-filled space that seems to encourage pluripotential stem cells to lay down fibrocartilaginous repair tissue. Because the hinge let the joint keep moving throughout, this repair process happened under functional loading rather than in a static joint - closer to the mechanical signals healthy cartilage normally receives.[4,8]

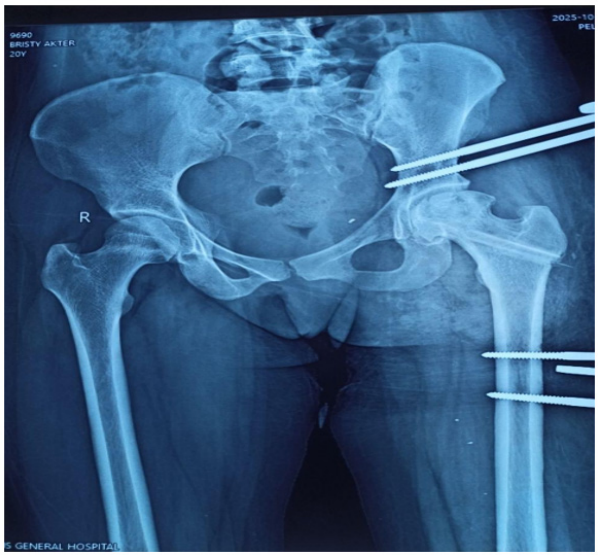

Figure 7 Radiograph on 21st postoperative day.

Throughout the ten days of active distraction, and for the full three months the frame was worn, she was encouraged to keep walking with support and took part in daily supervised hip exercise - active-assisted flexion, extension, and abduction. Bed rest was never the plan; the whole protocol depends on the joint moving gently and progressively while it is protected from full weight-bearing.[9]

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Frame removal and transition

The frame stayed on for three months, with regular clinical review and periodic radiographs. Somewhere between weeks six and eight she began reporting a marked drop in pain, matched by a genuine increase in hip range of motion on examination. By three months she was walking with minimal discomfort and met our criteria for frame removal.[7]

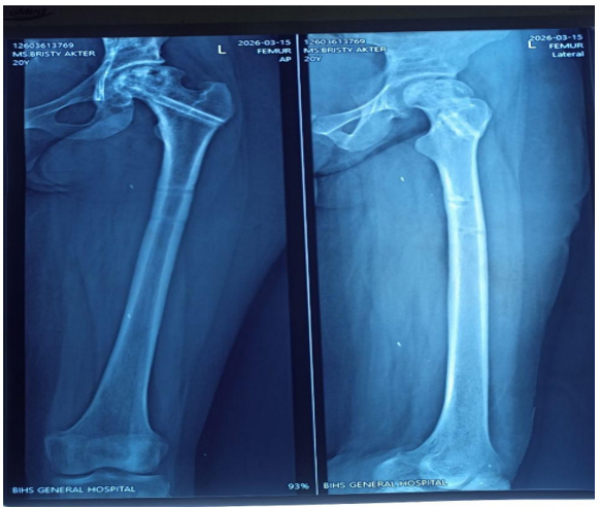

Figure 8 Radiograph after proper distraction and progressive weight-bearing, the frame was removed after 3 months of application.

The frame came off under sedation, and she was immediately fitted with a custom derotation bar, worn for 21 days. Three months post removal of Ilizarov apparatus the capsule, ligaments, and surrounding muscle adapted to a distracted position; taking the frame off without a step-down brace risks rotational instability or subluxation while those tissues re-adapt to normal loading. The derotation bar controls rotation while still letting the patient move the hip normally in flexion and extension, and supervised exercise continues throughout.[1,10]

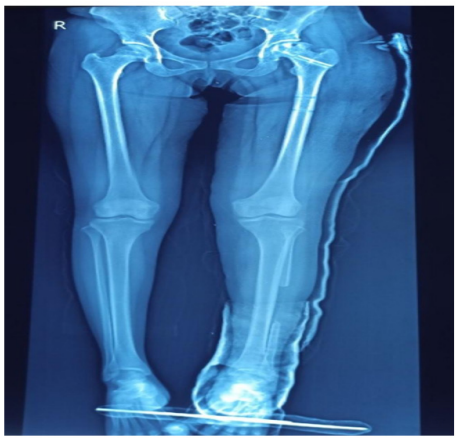

Figure 9 After removal of the Ilizarov frame, the limb was protected in a derotation bar.

Outcomes

Functional recovery

Recovery was steady and, frankly, better than we expected going in. By the time the frame came off at three months, she was already walking independently. The deep groin pain that had shaped her life for two years had faded to a mild, occasional ache, and her hips moved more freely than they had in a long time.[12]

At her most recent review - seven months after frame removal - she had returned fully to normal daily life: walking with a normal gait, no aids, climbing stairs without difficulty, and no pain at night. Both hips flexed past 90 degrees, her flexion contractures had resolved completely, and her Harris Hip Score fell in the excellent range. She was back to work and light recreational activity without restriction.

Radiographic and MRI findings

Follow-up radiographs showed the femoral head contours holding steady compared with the immediate postoperative films - no further collapse, no progressive joint-space narrowing, and clear subchondral consolidation on both sides.

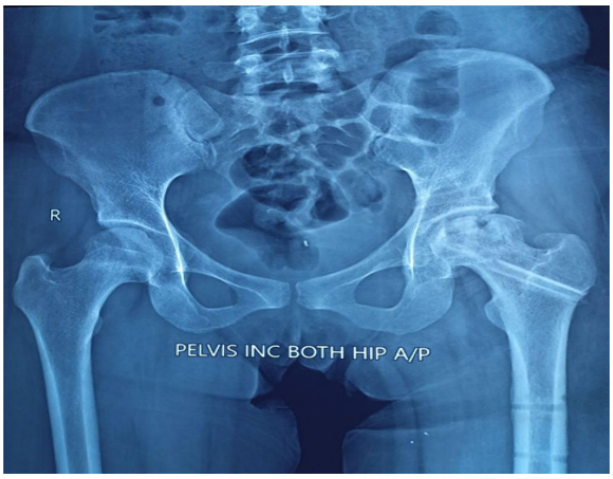

Figure 10 Follow-up radiograph two months after removal of Ilizarov apparatus.

A follow-up MRI showed a substantial drop in the bone-marrow oedema that had dominated her original scans, with the articular surfaces settled into a stable configuration. The joints are not structurally perfect, but they had reached a stable enough state to tolerate normal daily loading without further breakdown.

Complications

There were no major complications, intraoperative or postoperative. Careful daily pin-site care causes zero chance of infection, pin loosening, and pin-tract osteomyelitis - only minor, easily managed skin irritation occurred. No nerve or vessel injury, no problems at the fibular donor site, and no DVT, heterotopic ossification, or wound breakdown at either hip.

Figure 11 Six months after frame removal, the patient remained pain-free with no tenderness at the hip.

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Discussion

Managing advanced joint disease usually means weighing two goals against each other: relieving symptoms now, and keeping future options open. A 20-year-old with Stage IV femoral head osteonecrosis puts that tension in sharp relief.

A hip replacement would have solved her pain quickly, but at the cost of a lifetime of prosthetic complications - each future revision starting from a worse position, with less bone and a poorer chance of a good result than the last. Pushing arthroplasty back by even ten years through joint preservation is a meaningful gain for a patient this young.

The idiopathic nature of her disease is worth dwelling on. Despite an exhaustive work-up, we found no cause. That is not unusual - much of the literature on bilateral femoral head AVN in young adults describes patients without the classic risk factors. Silent hypercoagulable states, local microvascular problems, and genetic variants are all suspected culprits in such cases, but they are hard to pin down in routine practice. In the end, the stage of the disease mattered more to our surgical planning than its cause.[12,13]

Her failure to respond to oral ibandronic acid fits what is already known about bisphosphonates in late-stage disease. They work by slowing osteoclast activity to protect bone microarchitecture before it fails structurally; once the subchondral bone has already fractured and collapsed, as hers had, there is no remodelling strategy left that can reverse a mechanical failure. By the time she reached us, the window for medication to help had already closed.

Taken together, the three parts of our approach work through complementary mechanisms:

- Core decompression interrupts the ischaemic cycle by lowering intraosseous pressure and opening channels that recruit osteoprogenitor cells.
- The fibular graft addresses the structural gap directly, acting as a cortical column that props up the collapsed subchondral roof and a scaffold for new bone.

On their own, though, these two rarely hold up at Ficat–Arlet Stage IV, because the joint is still bearing the patient's full weight and muscle forces. That is where the third element earns its place: an articulated Ilizarov frame gives the joint internal reconstruction.

An 8–10 mm gap removes the friction and compression that would otherwise keep wearing down damaged cartilage. In that low-pressure, fluid-bathed space, fibrocartilaginous repair tissue has room to form. And because the hinge lets the hip keep moving during distraction, that repair happens under functional load rather than in a static joint, mirroring the mechanical signals that healthy cartilage relies on.

Starting distraction on day 3 protects the capsule's compliance before fibrosis sets in, and daily physiotherapy alongside early partial weight-bearing supplies the ongoing mechanical stimulus the repair tissue needs. The 21-day derotation bar after frame removal is a small step that we think matters a great deal - three months of external fixation leaves the soft tissues adapted to a distracted position, and taking the frame off without a step-down brace risks rotational instability while those tissues re-adapt.[7,10]

Seven months of follow-up is admittedly short. We do not yet know how durable the new repair tissue will prove, what will ultimately happen to the fibular graft, or whether she will eventually need a hip replacement decades from now. Longer follow-up is needed to answer those questions properly. Even so, her rapid recovery and radiographic stability at seven months go well beyond anything conservative management could have offered.[4]

Conclusion

When a 20-year-old presents with advanced, bilateral femoral head avascular necrosis (stage 4 on left side and stage 2 on right side), jumping straight to total joint arthroplasty deserves a second thought. This case shows that joint salvage can still succeed even after subchondral collapse, provided the biological and mechanical strategies are combined thoughtfully.

Core decompression, fibular grafting, and Ilizarov articulated hinge distraction (Ligamentotaxis) together address three different problems at once: raised intraosseous pressure, structural weakness, and joint compression. In this patient, that combination produced excellent functional recovery at seven months and let her keep her own hips and return to a normal life.

This does not mean every Stage IV hip can be saved. Careful patient selection, precise technique, and strict adherence to rehabilitation are all essential to a result like this one. But it does suggest that joint preservation deserves serious consideration before a young patient is told that replacement is her only option. Longer follow-up in this patient, and larger case series using this combined approach, will be needed to establish its place in the management of advanced femoral head osteonecrosis in young adults.

Acknowledgements

None.

Conflicts of interest

The author declares that there are no conflicts of interest.

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