Total Ankle Arthroplasty

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Introduction

- Replacement of the ankle joint with an artificial implant.
- Designed to treat patients with ankle arthritis.
- Alternative to ankle arthrodesis for the treatment of end-stage Ankle OA .
- Attempts to preserve functional ROM,
- Intended to provide a patient with mobility by restoring alignment, reducing pain and preserving the flexion/extension movement within the ankle joint

Indications for TAR	Favorable patient factors	Contraindications
Degenerative arthritis	older (middle- to old-aged), low demand, reasonably mobile	Local/systemic **infection** Previous history of infection in the affected joint is a relative contraindication
Post-traumatic arthritis	normal or low body mass index	**Insufficient** bone stock or bone quality Skeletal immaturity
Rheumatoid arthritis	well-aligned and stable hindfoot with good soft tissues conditions	Severe **instability,** maltracking or misalignment of the tibia and talus (unless correctable by surgery) **Charcot's disease** neuromuscular compromise vascular disease

Arthroplasty Vs Arthrodesis: general considerations

- Ankle arthrodesis (AA) and total ankle replacement (TAR) are standard treatments when :
  1. nonoperative management has failed.
  2. The success of a joint-preserving operation is very unlikely.
- AA results are predictable with a consistent pain relief once fusion is achieved.
- Recent modifications in TAR designs have challenged the perception that AA is the treatment of choice for end-stage ankle arthritis.
- The preservation of ankle motion in TAR is a theoretical advantage over AA

Decision making : AA Vs TAR

Major criteria

- Age
- Underlying cause of arthritis
- Deformity and ligamentous instability over hindfoot
- Ankle ROM
- Ipsilateral arthritis of adjacent joints

Minor criteria

- Soft tissues
- Activity level of patient
- Infection/ osteomyelitis
- AVN
- Patient compliance
- Comorbidities like DM
- BMI
- Patient request

Age of the patient

Arthrodesis

- Young patients with high functional demand.
- After all joint preserving options have been made out.

TAR

- Middle age to old patients with low functional demand.
- Minimum age of 50 years is recommended
- In a Swedish study, younger age was associated with osteolysis, loosening, and subsequently an increased risk of later revision
- TAR is occasionally also proposed for younger patients with bilateral ankle affliction, a low activity level caused by a medical condition other than ankle arthritis, and anticipated suffering from adjacent joint arthritis after AA (ie, rheumatoid patients).

Underlying cause of Arthritis

Arthrodesis

- Post traumatic end stage ankle arthritis in young individuals
- Neuromuscular dysfunction

TAR

- Rheumatoid arthritis
- Systemic collagen diseases
- Haemophilic arthritis

Deformity and ligamentous instability of hindfoot

Arthrodesis

- coronal plane deformity exceeding 10 to 15 degrees
- Proximal angulations difficult to correct with bone cuts
- Deltoid ligament incompetence

TAR

- Coronal plane deformity less than 10 degree
- Distal angulations
- Good ligamentous stability

Ankle Range Of Motion

Arthrodesis

- preoperative ankle motion of less than 10 degree without adjacent joint arthritis

TAR

- >10 degree ROM without adjacent joint arthritis
- even residual motion may be worth preserving by TAR in cases of severe adjacent joint arthritis

Ipsilateral Arthritis of adjacent joints

Arthrodesis

- Good adjacent joint anatomy

TAR

- patients with initial or advanced arthritis adjacent to the ankle joint that may eventually need additional arthrodeses of the hindfoot.

Soft tissues: equally important

Arthrodesis

- preferred in cases of tenuous and unfavorable soft tissues and should be performed arthroscopically whenever feasible

TAR

- Favourable soft tissue and vascular status

Authors' major and minor criteria for decision making regarding AA versus TAR

	Criterion	AA	TAR
Major	Age, y	<50	>60
	Underlying cause of arthritis	Posttraumatic, neuromuscular disease (spasticity)	Primary, rheumatoid and collagen-type disease, hemophilia, hemochromatosis
	Bilateral ankle arthritis	No	Yes
	Ankle range of motion	Poor (<10°)	Appropriate (>15°)
	Ipsilateral arthritis or arthrodesis of adjacent joints	Absent	Present
	Deformity and ligamentous instability of the hindfoot	Varus/valgus >15°, severe instability	Varus/valgus <10°, mild instability
Minor	Soft tissues/vascularization	Moderate angiopathy, tenuous soft tissue	Intact
	Previous infection or osteomyelitis	Yes	No
	Compliance	Poor	Appropriate
	Diabetes	Unstable	Well controlled
	BMI, kg/m^2	>25	<25
	Activity level	High	Low
	Avascular necrosis	Yes	No

If still in doubt after analyzing the major criteria, the minor criteria are also taken into consideration.

Summary

- comprehensive patient information
- the meticulous process of decision making regarding AA versus TAR is a prerequisite for superior outcomes.
- Incorrect indications lead to early failure and unsatisfied patients.
- If any doubt is left despite thorough decision making, the patient is usually better served with an AA.

Development of TAR

- First generation : 1970s
  - Most designs were highly constrained, or semi-constrained two component prostheses
  - used cement fixation on both the talar and tibial sides
  - high incidence of loosening, wide osteolysis, subsidence, and mechanical failure of prosthesis components
- Second generation : second half of the 1980s
  - two-component fixed-bearing systems with a polyethylene bearing surface incorporated into the talar or tibial component
  - more conservative bone cuts
  - elimination of bone cement in favour of press-fit designs with porous coating for bony ingrowth
- Third generation :
  - addition of a third component, an independent polyethylene mobile-bearing meniscus
  - place a greater importance on the use of ligaments to retain stability, the need for anatomic balancing following component insertion, and minimal bone resection.

CLASSIFICATION SYSTEM OF TOTAL ANKLE ARTHROPLASTIES

- Classification of TAR includes the following factors for consideration:

Fixation (cemented vs uncemented)

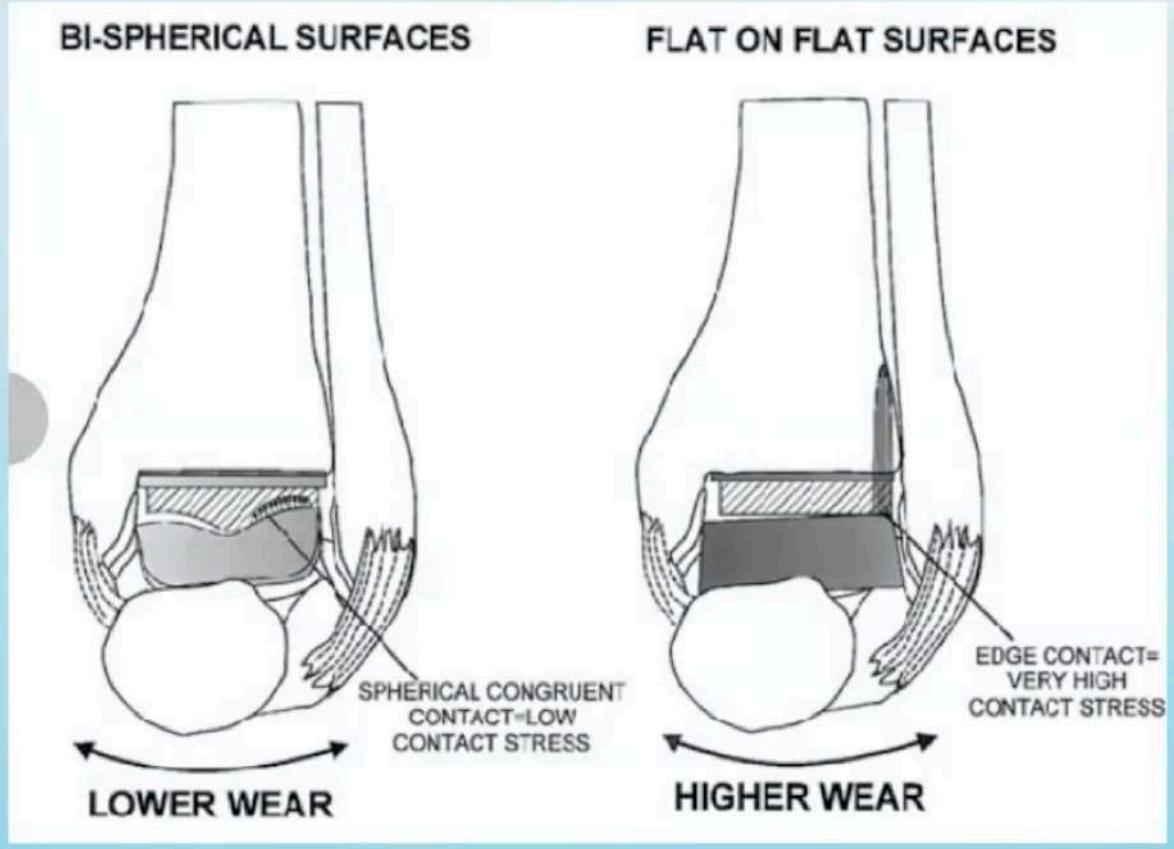
Number of components (2- vs 3-components)

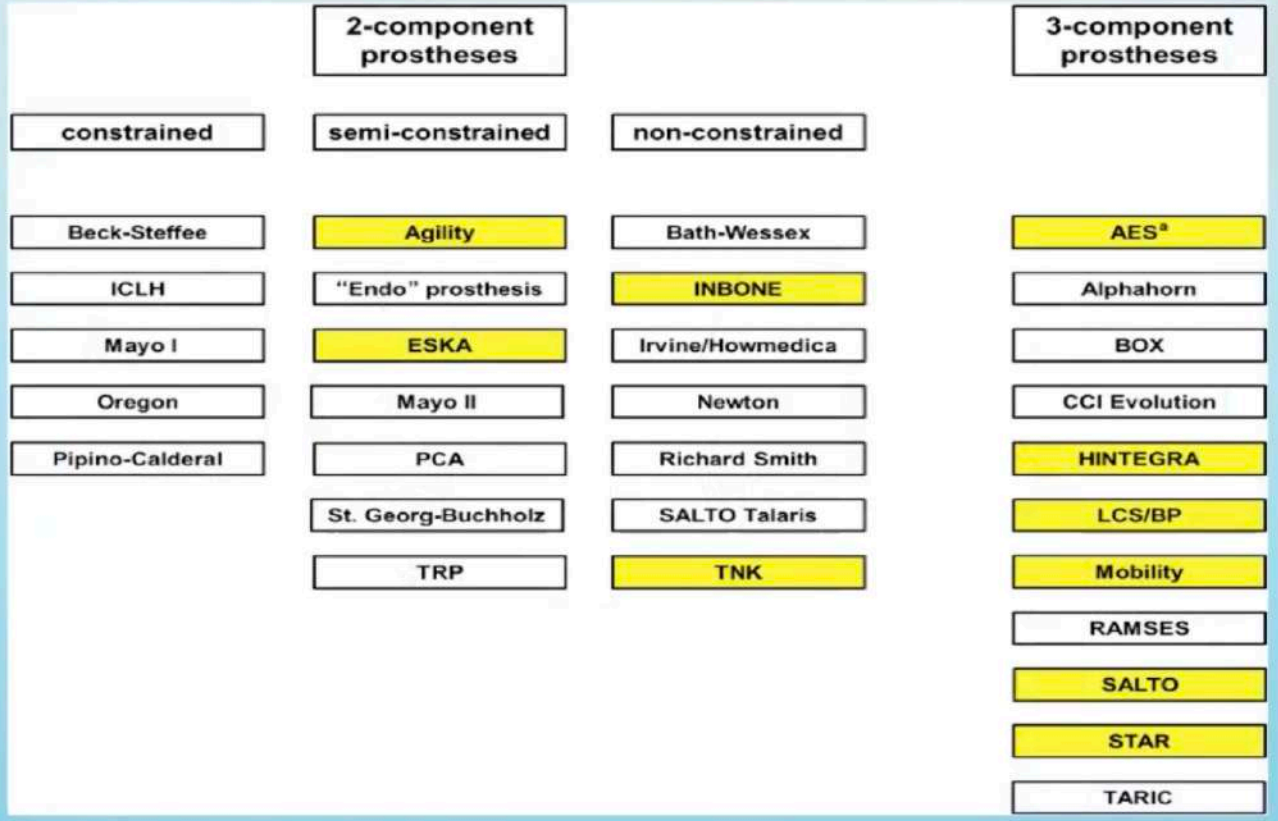
Constraint type (constrained vs semiconstrained vs unconstrained)

Congruency type (congruent vs incongruent)

Component shape (anatomic vs nonanatomic)

Bearing type (fixed vs mobile bearing)





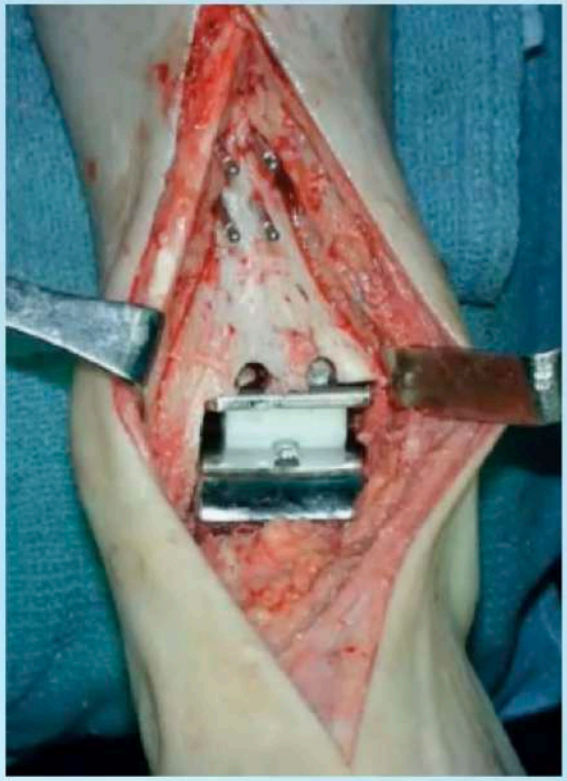
Pre operative planning

- Radiographs:
  - weight-bearing AP and lateral views of the ankle
- CT scan:
  - to ascertain adjacent joint arthritis if doubtful on X-Rays
- MRI :
  - presence of osteonecrosis, amount of involvement.
  - ligamentous integrity
- Additional work up may be needed to rule out neurological or vascular involvement

IAROM (IOWA Ankle ROM) device

Surgical approach

- supine position on a radiolucent table
- thick pad under the ipsilateral hip so the toes point toward the ceiling of the room
- vast majority of systems utilize an anterior approach to the ankle, via the interval between tibialis anterior and extensor hallucis longus
- Alternatively lateral approach with oblique osteotomy of fibula can also be used.



Technical considerations

- To restore mechanical alignment of the ankle
- Ligamentous balancing is a crucial part of the operative procedure
- imperative to achieve a stable, neutrally aligned, plantigrade, weight-bearing position of the ankle and hindfoot
  - ligament reconstruction, tendon transfers, osteotomies, heel cord lengthening and arthrodesis may be necessary
- soft tissue considerations

CLINICAL OUTCOMES AFTER TAR

- Gougoulias and colleagues recently performed a systematic review of the literature to analyze the outcome of TAR. (Gougoulias N, Khanna A, Maffulli N. How successful are current ankle replacements?:a systematic review of the literature. Clin Orthop Relat Res 2010;468: 199–208.)
- Thirteen level IV studies reporting on at least 20 replaced ankles with a minimum follow-up of 2 years were included in this review.
- The total patient cohort included 1105 cases: 234 Agility, 344 STAR, 153 Buechel- Pappas, 152 HINTEGRA, 98 Salto (Tornier SA, Saint Ismier, France), 70 TNK (Kyocera, Kyoto, Japan), and 54 Mobility.
- The overall survivorship of prosthesis component was 90% at 5 years, with a wide range between 68% and 100% among different centers.
- Based on available data analysis, no superiority of an implant design could be deduced.

- Although biomechanical studies show advantages of 3-component prosthesis design regarding biomechanics and kinematics, no obvious differences in clinical outcome between prosthesis types could be identified in the current literature.

- Valderrabano V, Hintermann B, Nigg BM, et al. Kinematic changes after fusion and total replacement of the ankle: part 1: range of motion. Foot Ankle Int 2003;24:881–7.

- Valderrabano V, Hintermann B, Nigg BM, et al. Kinematic changes after fusion and total replacement of the ankle: part 2: movement transfer. Foot Ankle Int 2003;24:888–96.

- Valderrabano V, Hintermann B, Nigg BM, et al. Kinematic changes after fusion and total replacement of the ankle: part 3: Talar movement. Foot Ankle Int 2003;24:897–900.

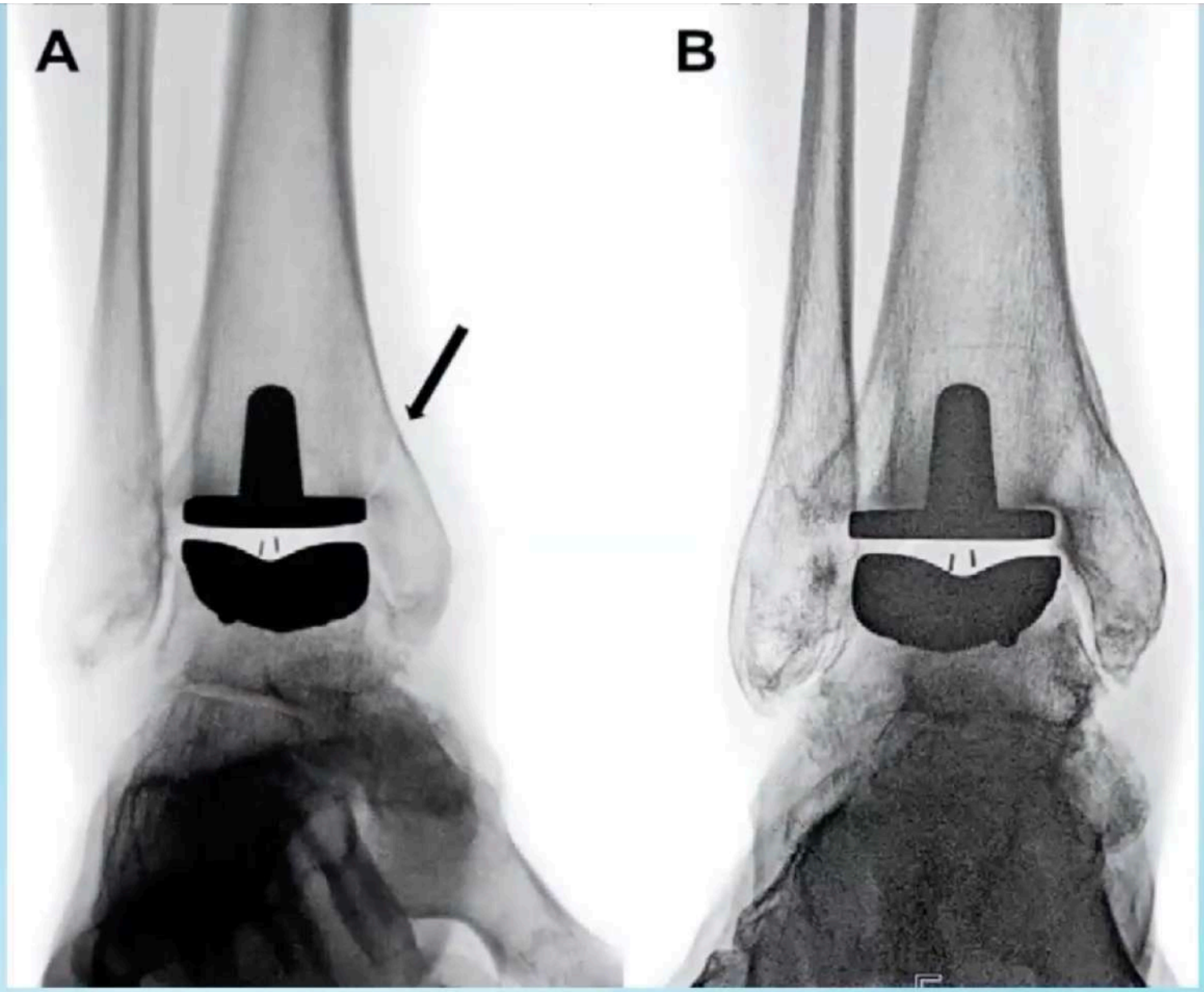
Complications of TAR

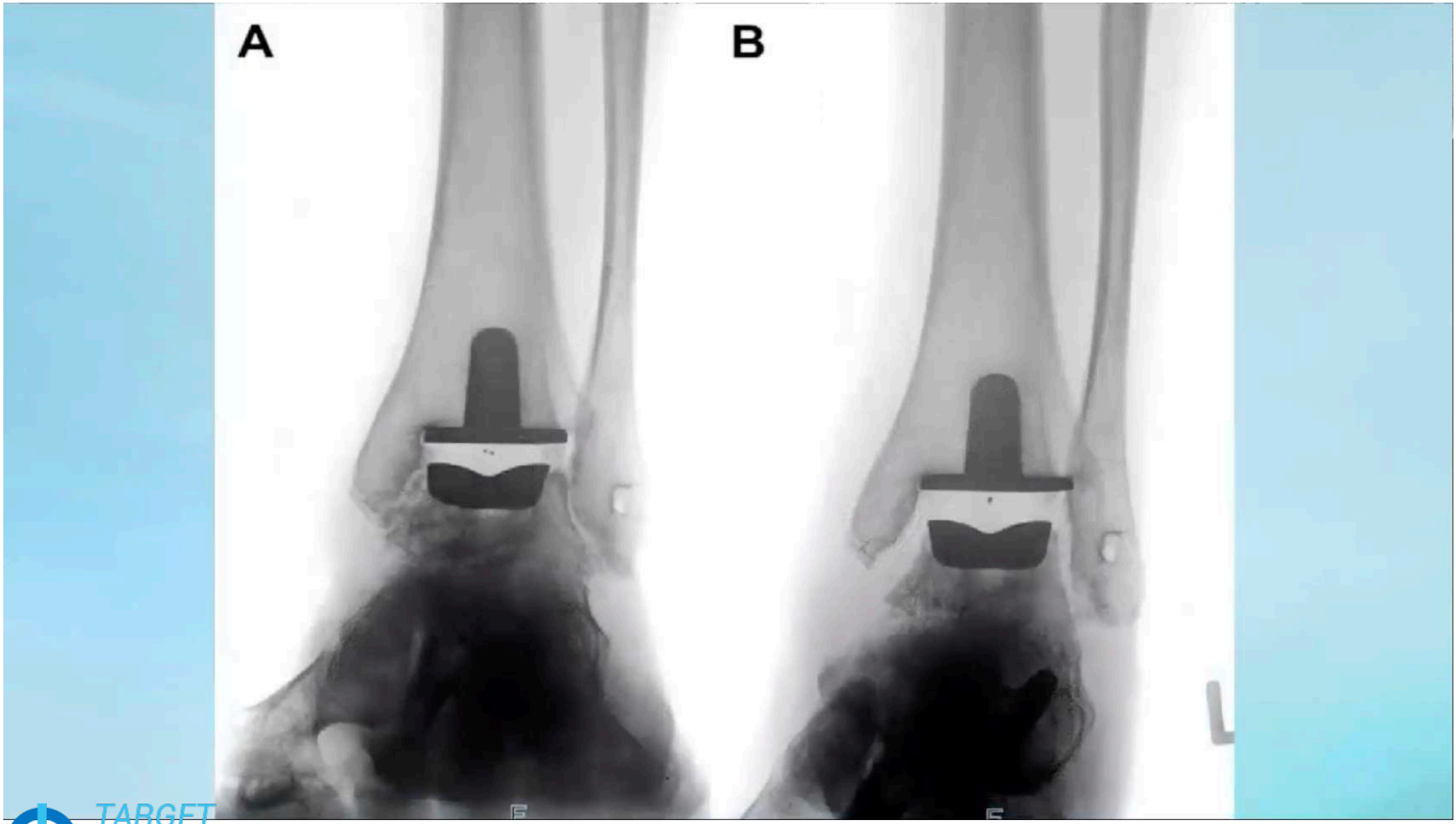
Intraoperative

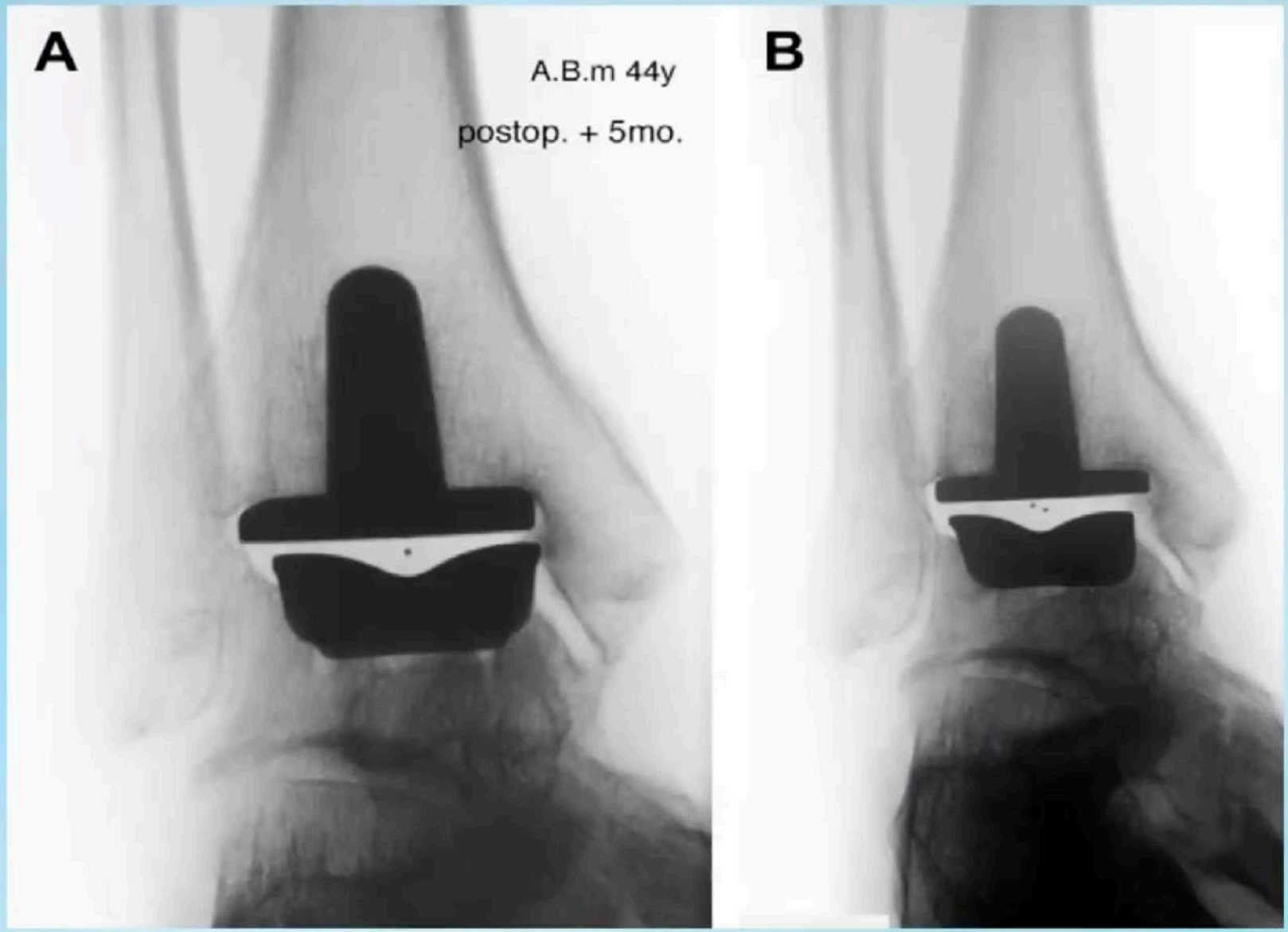
- Accidental cut of the lateral malleolus and the fracture of the medial malleolus
- Osteoporotic bone leading to unstable component
- Insufficient bone stock for correct implant fixation
- Ankle instability that cannot be corrected

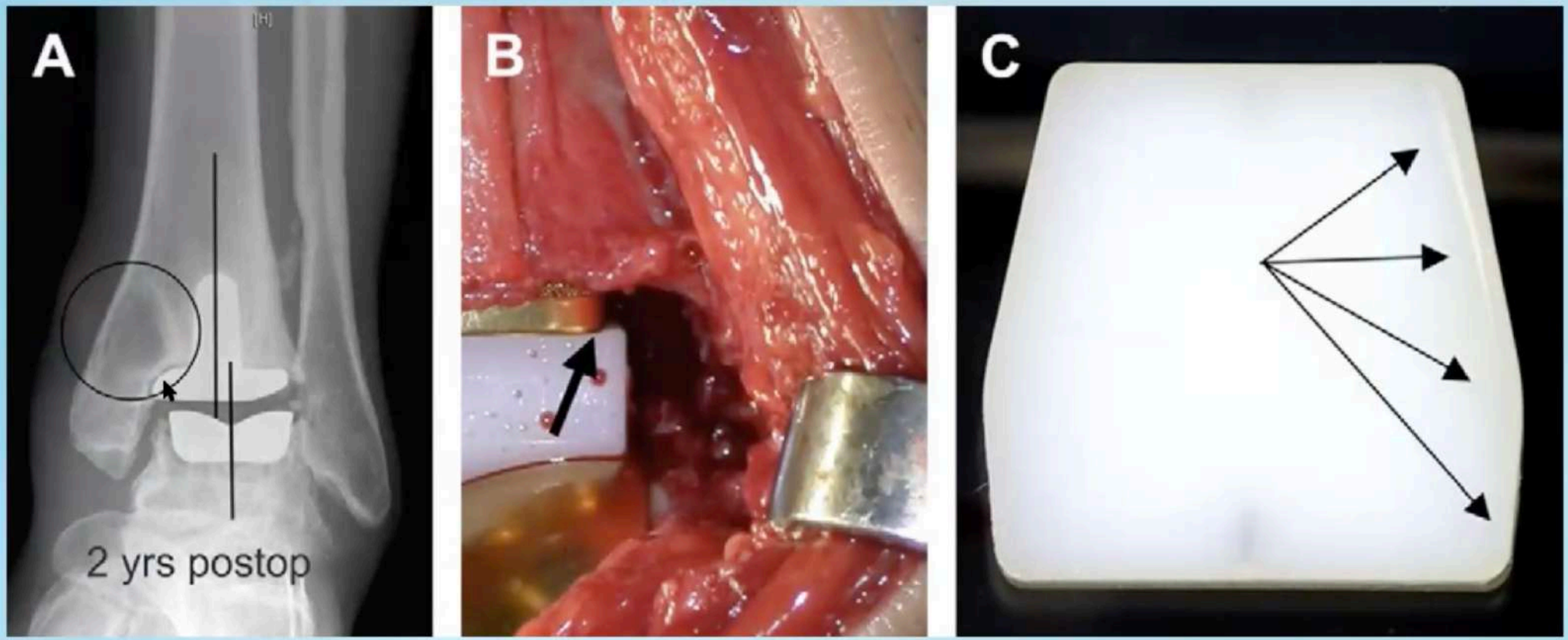
Post operative

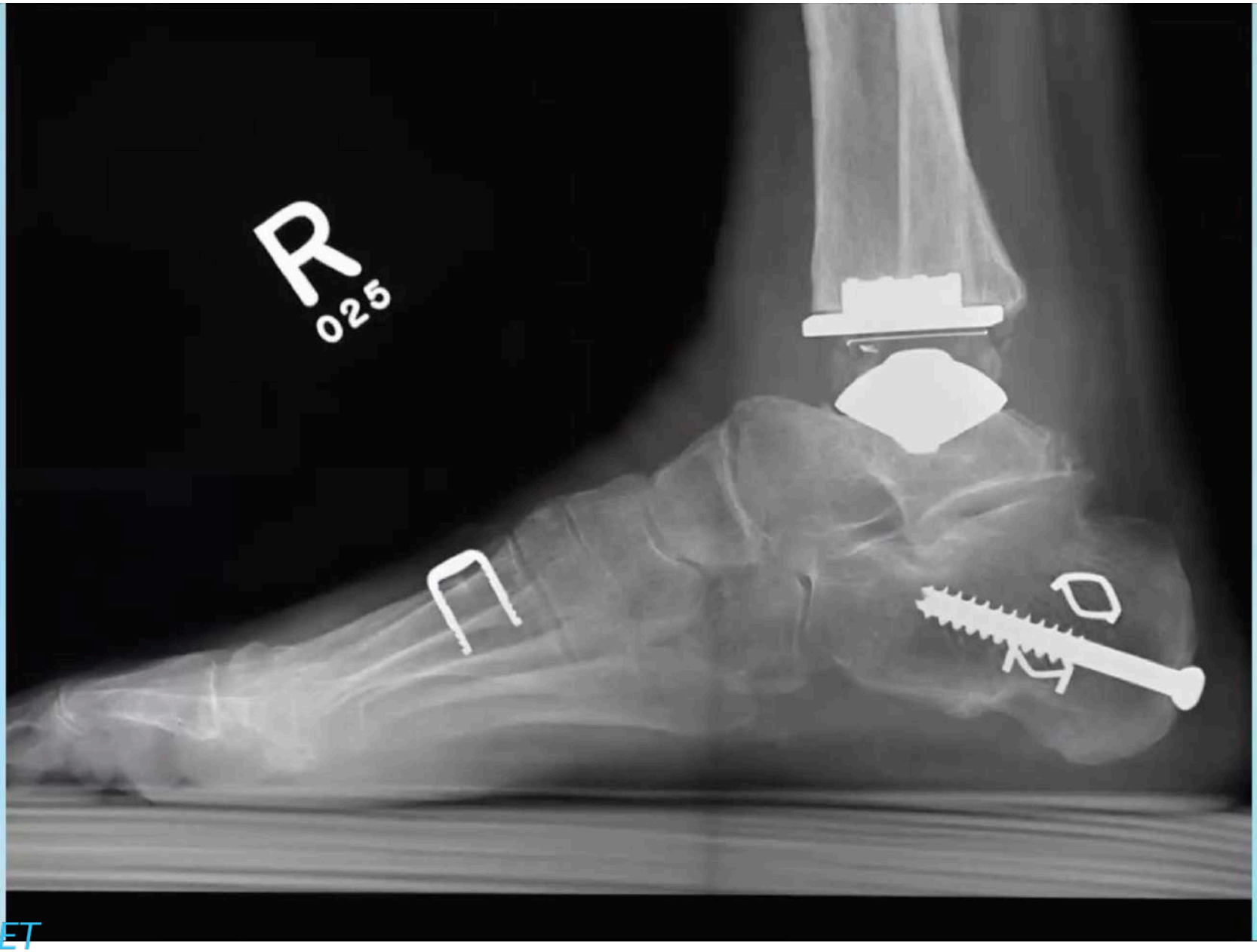
- Delayed wound healing
- Postoperative loss of motion
- Stress fracture of the medial malleolus
- Chronic anteromedial pain syndrome
- Pain in the malleolar gutter
- Painful osteophytes and ectopic bone
- Impingement caused by oversized/incorrectly implanted components
- Bone cysts
- Ankle instability
- Component loosening
- Acute infection
- Component subsidence/migration

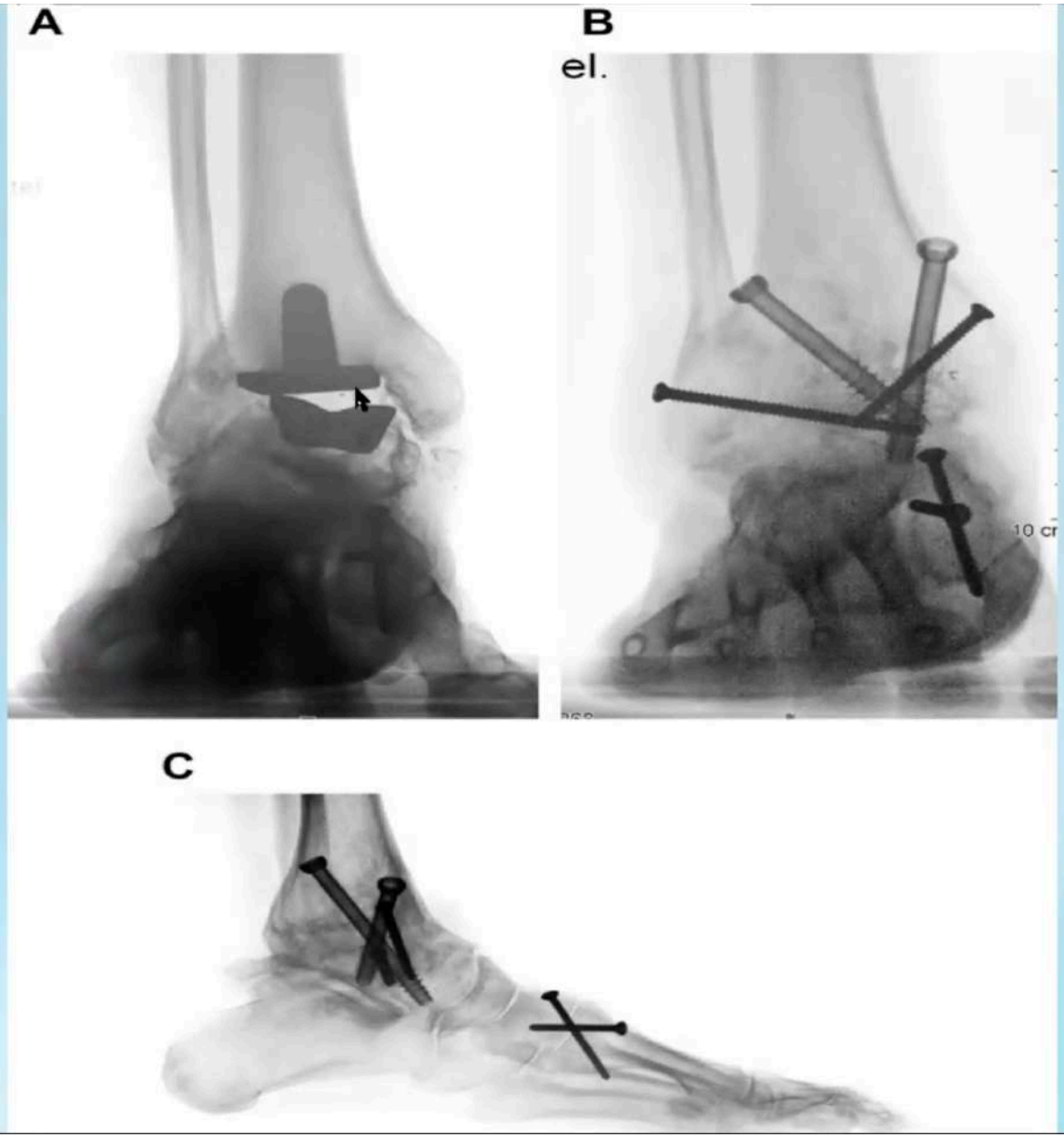












Summary

- TAR is undoubtedly gaining acceptance among foot and ankle surgeons as a valuable treatment option in patients with end-stage ankle OA.
- Current reports of this procedure show consistently good to excellent mid-term results with substantial pain relief, good functional outcome, and high patient satisfaction.

Ideal candidate for TAR

- Middle aged or older (sixth decade or older and, in general, the older the better)
- Low demands for physical and sports activities (e.g., hiking, swimming, biking, golfing)
- No significant comorbidities
- No smoking
- No obesity/overweight (normal or slightly increased body mass index; however, obesity is not a contraindication for this procedure)[17,26]
- Good bone stock with no risk factors for impaired bone quality
- Well-aligned and stable hindfoot
- Good soft tissue (e.g., no previous surgeries of foot/ankle)
- Well-preserved preoperative range of motion
- No neurovascular impairment of the lower extremity
- Reasonable expectations