1. EQUINUS DEFORMITY: CLINICAL FEATURES, ASSESSMENT AND MANAGEMENT

Introduction

Equinus deformity is a pathological condition of the foot, primarily characterized by plantar flexion of the ankle joint and a consequent inability to dorsiflex the foot (Fig. 1.1). Equinus deformity may be an isolated deformity or associated with equinovarus or equinovalgus deformity. This abnormality is most commonly observed in pediatric patients, particularly those diagnosed with cerebral palsy or congenital talipes equinovarus (clubfoot).

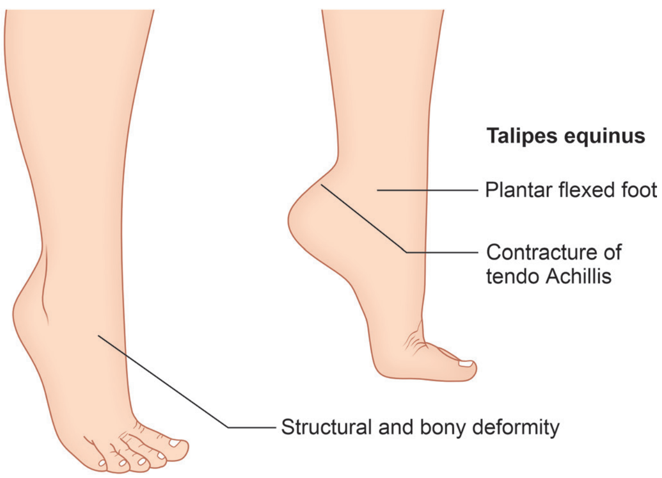

Fig. 1.1: Equinus deformity

Clinical Presentation

Children affected by equinus deformity typically exhibit a distinctive gait pattern. This includes toe-walking or a compensatory flexion of the hip and knees during ambulation. Such deviations in gait mechanics may lead to secondary complications, including contractures and pain in the hip and knee joints over time.

Assessment of Ankle Motion

In some cases, instability of the subtalar joint may obscure the presence of equinus deformity due to compensatory heel eversion and midfoot valgus positioning. Consequently, accurate evaluation necessitates specific examination techniques.

The ankle should be assessed by first placing the hindfoot in an inverted position and then performing plantar flexion. Maintaining the foot in this posture allows for an accurate assessment of true dorsiflexion range without interference from compensatory subtalar or midfoot movements.

Management Strategies (Fig. 1.2)

In Children Under 10 Years

In children younger than ten, equinus deformity is generally corrected through serial casting. Crucially, correction must be performed with the foot in inversion. Failure to adhere to this positioning may result in a false correction, inadvertently accommodating movement through the subtalar and midtarsal joints, rather than truly addressing the ankle deformity. If serial casting fails, it needs surgical correction: Posterior capsulotomy and tendo Achillis lengthening.

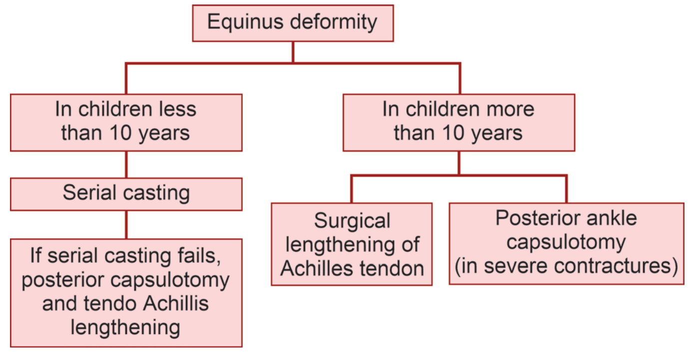

Fig. 1.2: Management of equinus deformity

In Older Children

For older pediatric patients, management often necessitates surgical lengthening of the Achilles tendon. In rare instances—particularly in cases involving long-standing and severe contractures—a posterior ankle capsulotomy may be indicated to achieve full correction.

Talipes Equinovarus (Clubfoot)

Clinical Features

Talipes equinovarus is a complex deformity comprising multiple components:

- Ankle equinus
- Midtarsal inversion
- Forefoot adduction and supination
- Cavus deformity, particularly in chronic cases.

Management

Ponseti Method (Figs 1.3 and 1.4)

The standard approach to correction involves the Ponseti technique, which utilizes serial casting to gradually realign the foot. In select cases, an Achilles tendon tenotomy may be necessary to achieve adequate dorsiflexion.

Muscle Function and Surgical Interventions

In this condition, the peroneal muscles typically demonstrate paralysis or severe weakness, while the posterior tibial muscle remains functional. In such scenarios, surgical management may include posterior tibial tendon transfer, using one of the following techniques:

- *Barr procedure*: The posterior tibial tendon is threaded through the interosseous membrane and anchored to the third metatarsal or the third cuneiform using sutures (Fig. 1.5).
- *Ober technique*: The tendon is rerouted into the anterior compartment of the leg, avoiding passage through the interosseous membrane (Fig. 1.6).

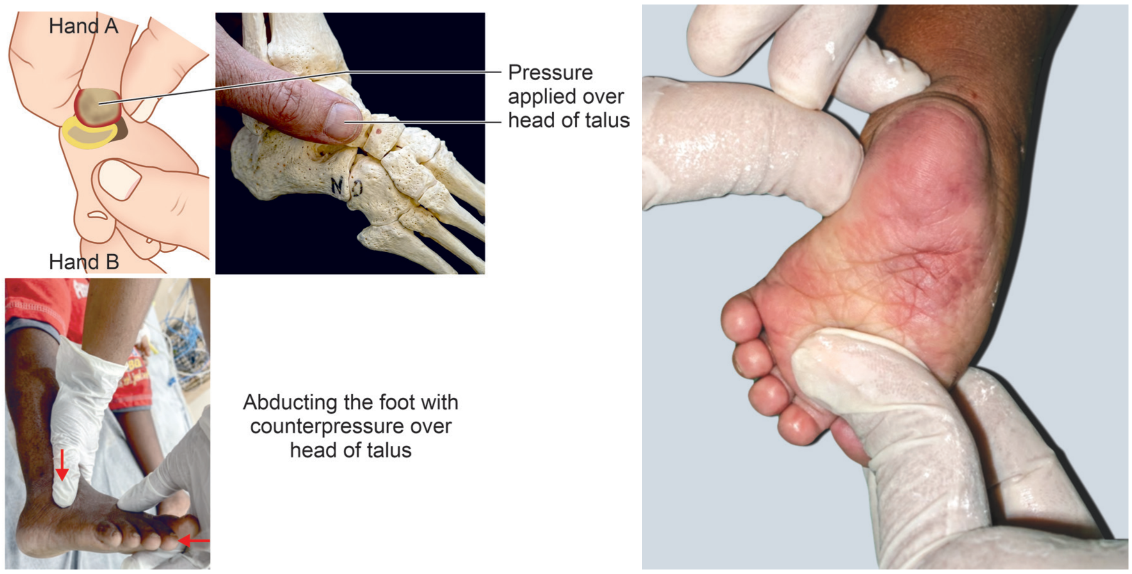

Fig. 1.3: Counterpressure over head of talus followed by kinematic coupling (varus deformity correction)

Fig. 1.4: Cavus correction and Ponseti cast

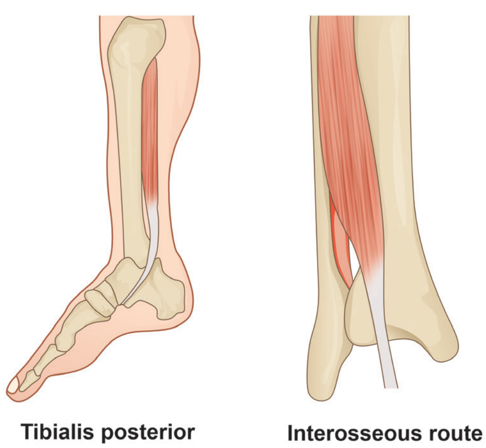

Fig. 1.5: Barr procedure

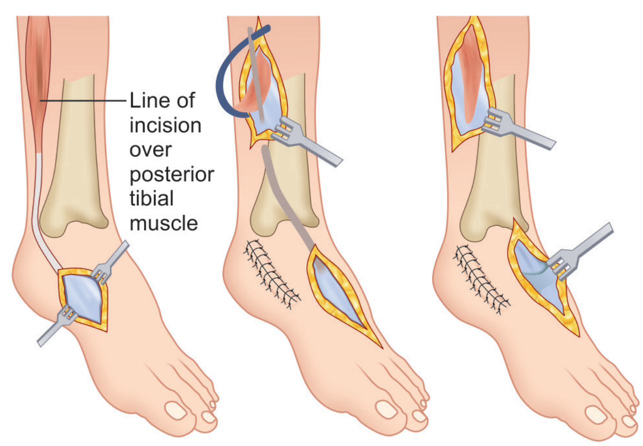

Fig. 1.6: Ober technique

Talipes Equinovalgus

Pathophysiology

Talipes equinovalgus is defined by a muscle imbalance, wherein the anterior and posterior tibial muscles are relatively weak, while the peroneus longus, peroneus brevis, and the gastrocnemius–soleus complex are comparatively stronger. This imbalance contributes to the valgus and equinus positioning of the foot.

Surgical Management

- In cases where only the anterior tibial muscle is paralyzed, surgical transfer of the peroneus longus tendon to the first cuneiform may restore function and correct deformity.

- When the posterior tibial muscle is affected, several donor tendons may be considered for transfer, including:
  - Peroneus longus
  - Flexor digitorum longus
  - Flexor hallucis longus
  - Extensor hallucis longus.

Combined Tibial Muscle Paralysis

In the rare but severe event of combined anterior and posterior tibial muscle paralysis, a more extensive surgical intervention is warranted. This involves an extra-articular subtalar arthrodesis, typically performed in conjunction with:

- Correction of equinus deformity
- Achilles tendon lengthening.

Conclusion

Equinus deformity and associated variants—talipes equinovarus and talipes equinovalgus—represent complex musculoskeletal conditions requiring precise assessment and a patient-specific approach to management. Early intervention, accurate anatomical evaluation, and the application of appropriate conservative or surgical techniques are critical to achieve functional correction and preventing long-term disability.

2. PERIPROSTHETIC FRACTURES OF THE HIP: CLASSIFICATION, PREVENTION AND MANAGEMENT

Introduction

Periprosthetic fractures of the hip are a significant clinical challenge encountered in both primary and revision total hip arthroplasty. These fractures occur adjacent to prosthetic components and can significantly impact postoperative outcomes. Effective management depends on precise classification, identification of risk factors, and the application of appropriate surgical techniques. The Vancouver classification system, developed by Duncan and Masri, is the most widely accepted framework for categorizing these fractures based on anatomical location, implant stability, and bone quality.

Vancouver Classification System

1. Intraoperative Classification (Fig. 2.1)

- **Type A fractures:** These occur in the trochanteric region and may involve either the greater or lesser trochanter.
- **Type B fractures:**

  Occur around or just distal to the femoral prosthesis stem. These are further subdivided into:
  - *Type B1*: The femoral stem is well-fixed.
  - *Type B2*: The stem is loose, though proximal bone stock is adequate.
  - *Type B3*: The stem is loose and there is severe bone loss or fragmentation in the proximal femur.
- **Type C fractures:** These occur well below the femoral prosthesis stem and do not affect the stability of the implant.

2. Postoperative Classification

The Vancouver system also applies to postoperative periprosthetic fractures:

- **Type A fractures:** Confined to the trochanteric region (Fig. 2.2):
  - *Type A(G)*: Involves the greater trochanter.
  - *Type A(L)*: Involves the lesser trochanter.

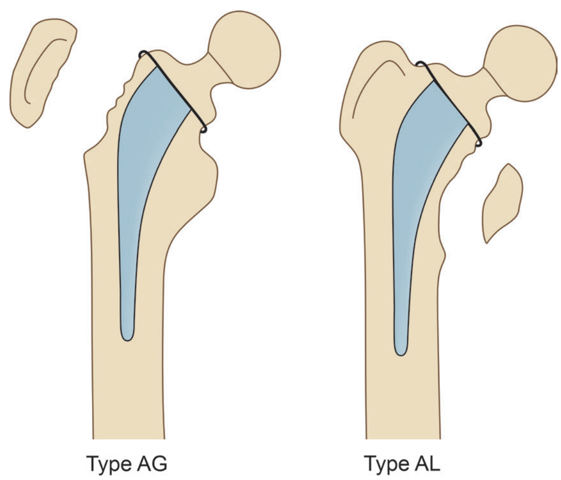

Fig. 2.2: Type A fractures

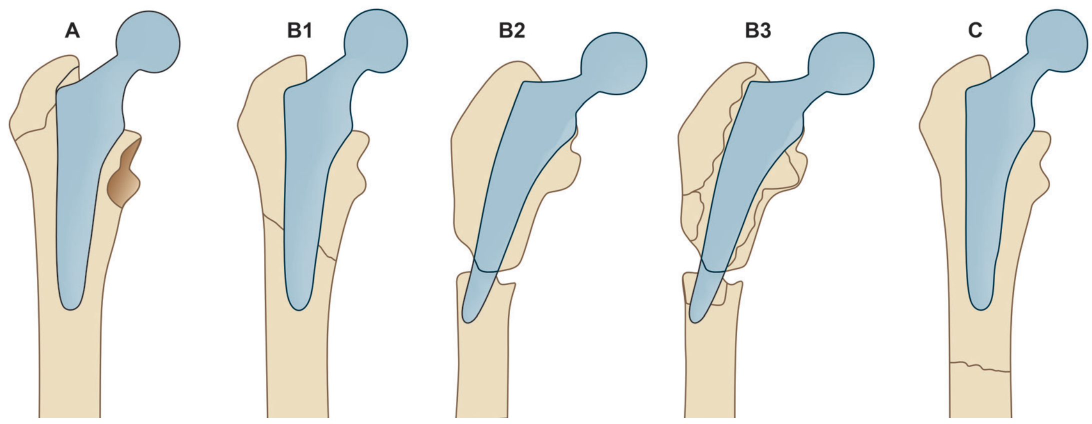

Fig. 2.1: Vancouver intraoperative classification of periprosthetic fractures

- **Type B fractures:** Located around or just below the prosthesis stem (Fig. 2.3):

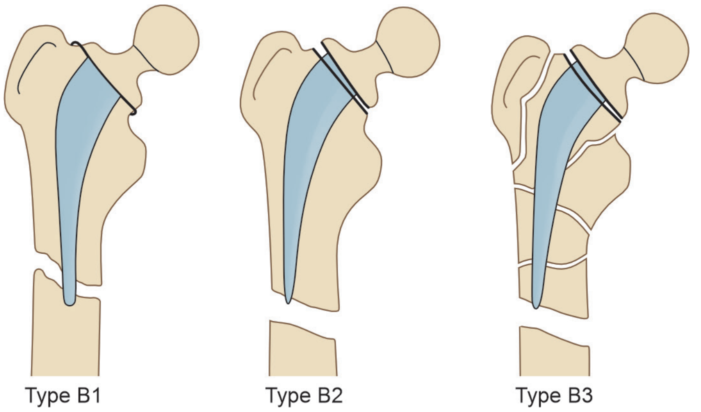

Fig. 2.3: Type B fractures

  - *Type B1*: The stem is well-fixed.
  - *Type B2*: The stem is loose, but bone quality remains sufficient.
  - *Type B3*: The stem is loose, and bone stock is severely compromised.
- **Type C fractures:** Found distal to the prosthesis stem, with the implant typically remaining stable (Fig. 2.4).

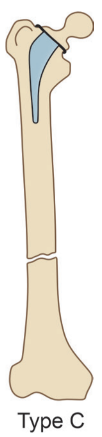

Fig. 2.4: Type C fractures

Prevention of Periprosthetic Fractures

Prevention plays a critical role in minimizing the incidence of periprosthetic fractures, particularly during arthroplasty procedures. Key preventive strategies include:

- **Risk factor identification:** Careful preoperative evaluation to identify patients with conditions such as osteoporosis, rheumatoid arthritis, or previous surgeries is essential.
- **Adequate surgical exposure:** Ensuring sufficient visualization and access during both primary and revision surgeries helps avoid intraoperative fractures.
- **Caution with cementless implants:** Particular attention should be paid when using cementless femoral components in patients with rheumatoid arthritis or severe osteopenia.
- **Management of cortical perforations:** Use of reinforcing implants, structural bone grafts, or fracture plates can mitigate stress risers caused by cortical breaches.
- **Timely revision of failing implants:** Elective revision of prostheses due to mechanical failure or osteolysis may prevent progression to fracture.

Management of Periprosthetic Fractures

Treatment varies according to fracture type, implant stability, and bone quality. Below is an overview based on the Vancouver classification:

Type A Fractures

These fractures are often related to osteolysis. Management involves addressing the underlying osteolytic process, sometimes in conjunction with fragment stabilization.

Type B Fractures

- **B1 fractures:** Managed via open reduction and internal fixation (ORIF) using cortical strut grafts, cerclage wiring, or locking plates, preserving the well-fixed femoral stem (Fig. 2.5).

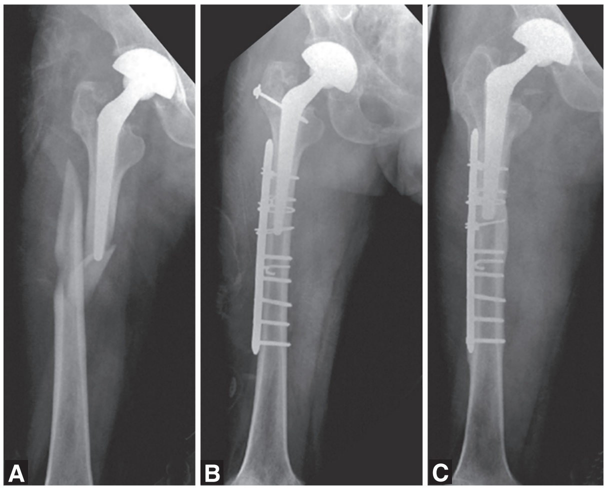

Fig. 2.5: Management of B1 fractures

- **B2 fractures:** Require revision of the femoral component, often with modular or long-stem implants, combined with stabilization of the fracture fragments (Fig. 2.6).

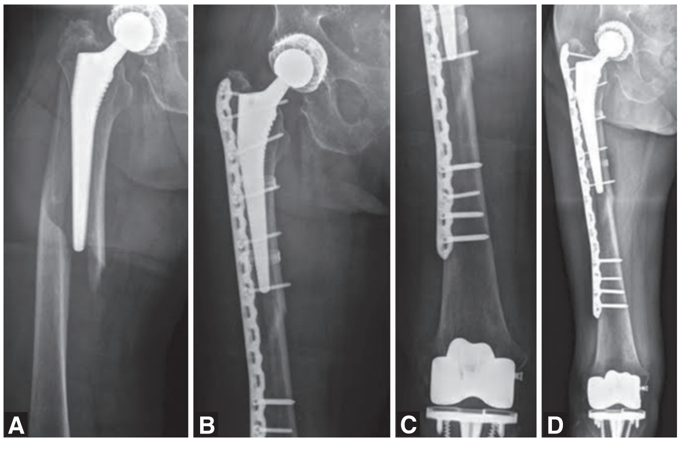

Fig. 2.6: Management of B2 fractures

- **B3 fractures:** These complex fractures necessitate revision of the femoral component and may involve proximal femoral allografts, impaction bone grafting, or even proximal femoral replacement in severe cases (Fig. 2.7).

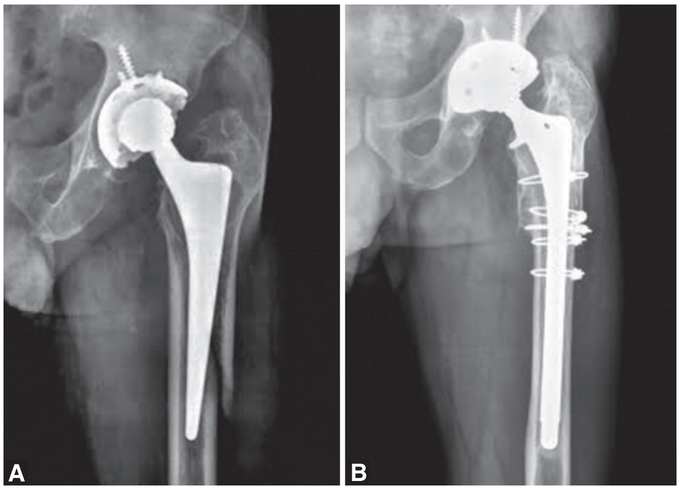

Fig. 2.7: Management of B3 fractures

Type C Fractures

As these occur distal to the prosthesis, the implant is typically unaffected. Management consists of open reduction and internal fixation, ensuring mechanical stability while leaving the hip prosthesis intact (Fig. 2.8).

Fig. 2.8: Management of type C fractures

Conclusion

Periprosthetic fractures of the hip, particularly following total hip arthroplasty, present multifaceted diagnostic and therapeutic challenges. The Vancouver classification system serves as a foundational tool in guiding clinical decision-making. Optimal outcomes depend on accurate fracture classification, timely identification of risk factors, and the implementation of individualized, evidence-based treatment protocols.

3. DUPUYTREN'S CONTRACTURE: PATHOPHYSIOLOGY, CLINICAL FEATURES AND MANAGEMENT

Definition

Dupuytren's contracture (Fig. 3.1) is a benign fibroproliferative disorder of the palmar fascia, leading to progressive digital flexion contractures, most commonly affecting the ring and little fingers.

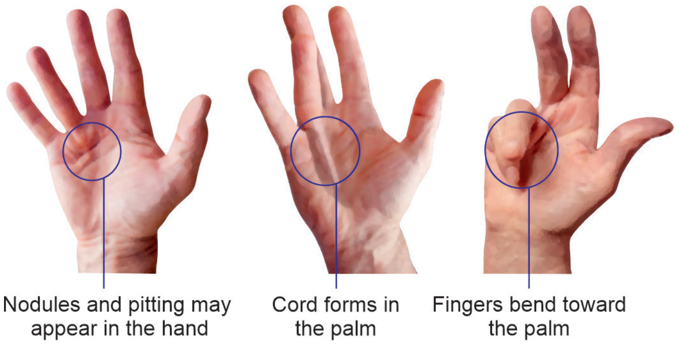

Fig. 3.1: Dupuytren's contracture

Etiology and Risk Factors

Idiopathic, but associated with:

- Genetic predisposition (autosomal dominant with variable penetrance)
- Male gender (M:F = 7:1)
- Age more than 40 years
- Repeated microtrauma
- Northern European descent ("Viking disease")
- Diabetes mellitus
- Alcoholism
- Epilepsy (possibly related to anticonvulsant use)
- Smoking
- HIV infection

Dupuytren's Diathesis

- Dupuytren's diathesis refers to a predisposition for aggressive, recurrent, and bilateral Dupuytren's contracture, often associated with factors like early onset, family history, ectopic lesions (e.g. Garrod's pads), and involvement of multiple digits.

Pathophysiology

- Abnormal myofibroblast proliferation and collagen (Type III) deposition within the pretendinous bands of the palmar fascia.
- Formation of nodules and cords causing MCP and PIP joint flexion contractures.
- Typically spares the extensor tendons and neurovascular structures unless severe.

Anatomical Structures Involved (Fig. 3.2)

- Pretendinous bands
- Spiral band

- Natatory ligament
- Lateral digital sheet
- Grayson's and Cleland's ligaments.

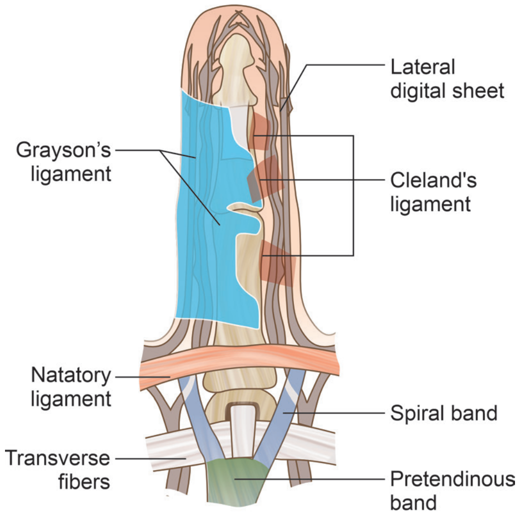

Fig. 3.2: Anatomical structures involved in Dupuytren's contracture

Clinical Features

- Painless palmar nodule
- Progressive flexion deformity, primarily of the 4th and 5th digits
- Positive Hueston's tabletop test (Fig. 3.3)
- Bilateral involvement in ~45% cases
- Possible association with Garrod's knuckle pads, Peyronie's disease, plantar fibromatosis (Ledderhose disease)

Fig. 3.3: Hueston's tabletop test

Histological Stages

Proliferative stage:

- Presence of large myofibroblasts.

Involutional stage:

- Formation of a dense myofibroblast network.
- Increased ratio of type III to type I collagen.

Residual stage:

- Disappearance of myofibroblasts.
- Predominance of smaller populations of fibrocytes.

Differential Diagnosis

Table 3.1.

Indications for Treatment

- MCP contracture more than 30 degrees
- Any degree of PIP joint contracture
- Progressive deformity impacting hand function.

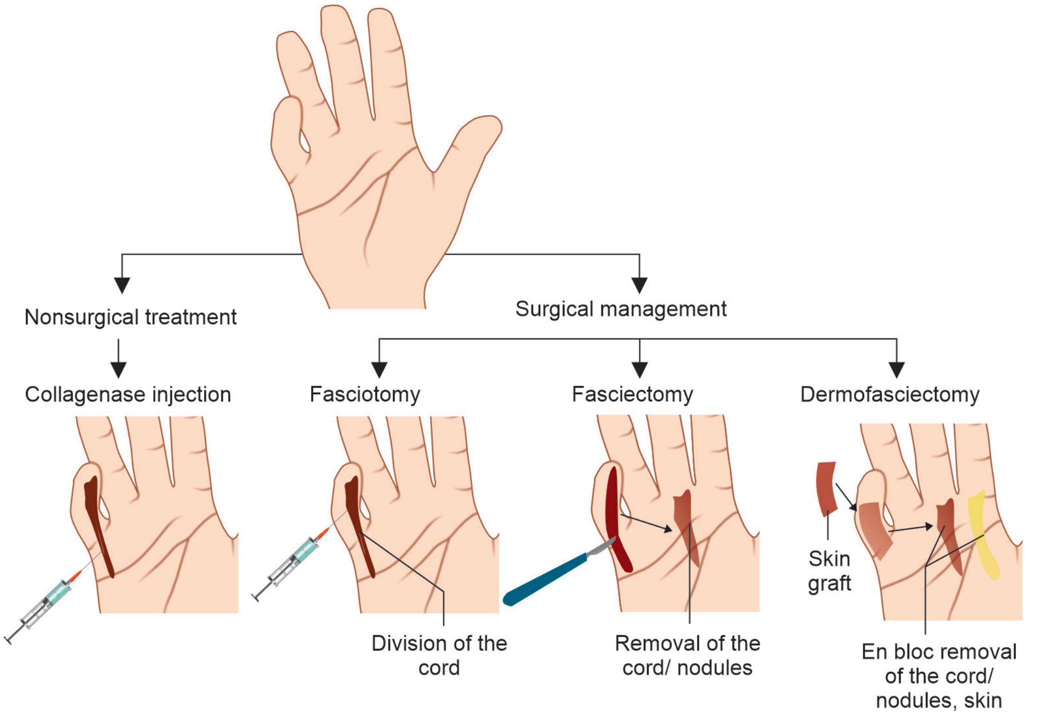

Fig. 3.4: Management of Dupuytren's contracture

Table 3.1: Differential diagnosis		
Condition	**Key features**	**How to differentiate from Dupuytren's contracture**
Dupuytren's contracture	• Painless palmar nodules and cords progressive flexion deformity • Most commonly in ring and little fingers	• No triggering • No history of ischemia or trauma • Palpable cords and nodules
Trigger finger	• Stenosing tenosynovitis of flexor tendon sheath • Painful clicking/snapping on finger movement • Tenderness over A1 pulley • Locking in flexion correctable	• Presence of painful snapping • No palmar cords • Tenderness A1 pulley region
Volkmann's ischemic contracture	• Fixed flexion deformity of wrist and fingers • History of compartment syndrome or forearm ischemia	• Clear history of ischemia/trauma • Involvement wrist + multiple fingers • Muscle wasting, nerve signs
Pseudo-Dupuytren's (secondary to trauma) contracture	• Flexion deformity secondary to trauma (scar formation or tendon injury)	• History of trauma • No characteristic nodules/cords • Localized contracture to injury site

Management (Fig. 3.4)

Non-operative

- Observation for mild, non-progressive cases
- Collagenase *Clostridium histolyticum* injections (Xiaflex) — enzymatic fasciotomy
- Needle aponeurotomy (percutaneous fasciotomy)

Operative

- Limited fasciectomy (most common)
- Dermofasciectomy (for recurrent disease)
- Segmental or total fasciectomy (rare)
- Post-op splinting and physiotherapy essential to prevent recurrence.

Postoperative Rehabilitation

Splinting

- Initially static for 2 weeks with MCP in 10–20° Flexion, PIP.
  Straight and DIP joint free
- After 2 weeks PIP splint at night for 8–10 weeks
- The patient is warned not to place the hand in a dependent position for rest and not to soak the hand in hot water
- The resting pan splint is worn for 3 months after surgery.

Complications

- Recurrence (higher in younger patients and severe disease)
- Neurovascular injury
- Complex regional pain syndrome (CRPS)
- Wound healing issues, hematoma

Prognosis

- Recurrence rates vary between 20–60% depending on method used.
- Proximal interphalangeal joint contractures have worse outcomes compared to metacarpophalangeal joint.

4. VACUUM-ASSISTED CLOSURE (VAC) THERAPY: PRINCIPLES, APPLICATION AND COMPLICATIONS

Introduction

Vacuum-assisted closure (VAC) therapy (Fig. 4.1) utilises the suction method, it is an advanced wound management technique that utilizes controlled levels of negative pressure to enhance and accelerate wound healing. This method has proven beneficial in a variety of acute and chronic wounds by promoting tissue regeneration and reducing the need for more invasive reconstructive procedures.

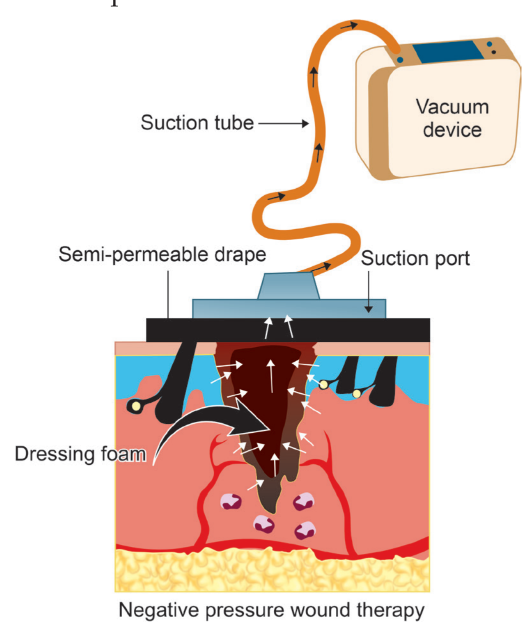

Fig. 4.1: VAC therapy

Advantages of VAC Therapy

VAC therapy offers several clinical benefits in wound management:

- **Enhanced granulation tissue formation**: Promotes rapid and robust granulation by stimulating cellular proliferation.

- **Reduction in wound volume**: Negative pressure leads to mechanical contraction of the wound margins.
- **Tissue decompression**: Facilitates removal of interstitial fluid, thereby reducing edema and associated tissue tension.
- **Minimized need for skin grafting**: Reduces or eliminates the necessity for split-thickness skin grafts and local flap coverage, particularly in well-vascularized wound beds.

Components and Application Technique

Key Components

- **Polyethylene sponge**: A biocompatible open-cell foam with pore sizes ranging between 200–400 micrometers is placed directly onto the wound bed.
- **Occlusive adhesive dressing**: Surrounding skin is sealed with a plastic adhesive drape, isolating the wound from the external environment.
- **Suction interface**: A small window is cut into the occlusive sheet above the sponge, over which a flexible suction tube is affixed.
- **Reservoir and vacuum pump**: The other end of the suction tube connects to a clear plastic reservoir, which in turn is attached to a vacuum pump.

Operational Parameters

Once sealed, the system functions as a closed-loop unit, maintaining a continuous negative pressure typically ranging from 50–150 mmHg, with 125 mmHg being the most commonly applied setting.

Mechanism of Action

The therapeutic benefits of VAC therapy are derived from multiple synergistic mechanisms:

- **Mechanical strain and angiogenesis**: The applied negative pressure induces mechanical strain on cells, enhancing the expression of growth factors and stimulating angiogenesis, analogous to the biological principles of the Ilizarov technique used in distraction osteogenesis.
- **Edema reduction and microcirculation enhancement**: Removal of excess interstitial fluid alleviates tissue swelling, thereby improving local blood flow and tissue oxygenation.
- **Reduction of contaminants**: Continuous suction helps remove soluble wound contaminants, bacterial bioburden, and pro-inflammatory mediators, creating a cleaner wound environment.
- **Application versatility**: VAC therapy can be safely used over exposed bone, tendons, or orthopedic implants, expanding its role in complex wound care.

Complications of VAC Therapy

While generally well-tolerated, VAC therapy is associated with certain complications:

- **Bleeding**: Common during sponge removal or replacement, especially if the sponge adheres to granulated tissue or erodes an underlying blood vessel. Precaution: Avoid placing VAC foam directly over exposed vessels or nerves.
- **Pain**: Often reported during sponge changes, attributed to tissue ingrowth into the foam material.
- **Skin injury**: Includes tearing of fragile skin, particularly in elderly or malnourished patients.
- **Skin irritation**: May result from adhesive drapes, negative pressure, or extended use.

Conclusion

Vacuum-assisted closure therapy represents a significant advancement in the management of complex wounds, offering a minimally invasive approach to stimulate healing, reduce wound size, and optimize the wound environment. Awareness of its mechanism, application technique, and potential complications is essential for safe and effective clinical use.

5. BONE TRANSPORT: PRINCIPLES, INDICATIONS AND SURGICAL TECHNIQUES

Introduction

Bone transport (Figs 5.1 and 5.2), also known as distraction osteogenesis, is a surgical technique pioneered by Gavriil Ilizarov for the reconstruction of skeletal defects. This method involves the gradual movement of a bone segment to bridge a defect, while simultaneously stimulating new bone and soft tissue formation. It is primarily utilized in conditions involving large bony gaps or complex non-unions.

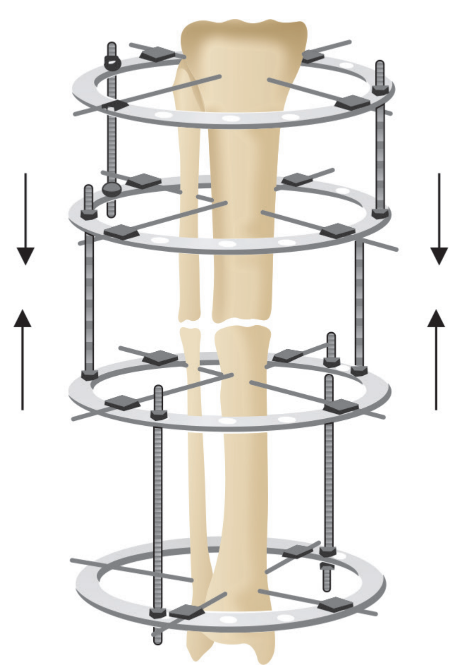

Fig. 5.1: Ilizarov fixator

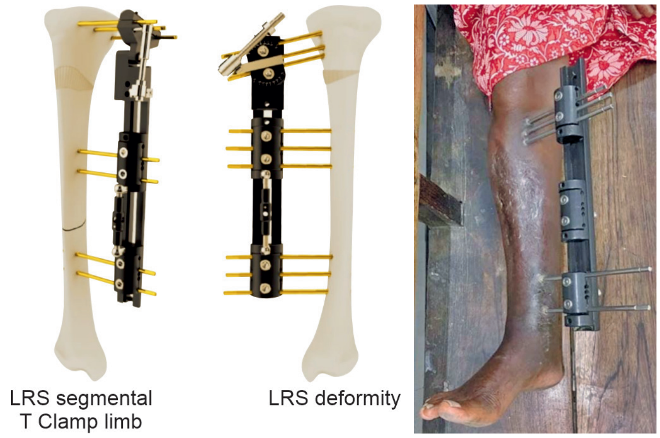

Fig. 5.2: Limb reconstruction system (LRS)

Indications for Bone Transport

Bone transport is employed in the treatment of various musculoskeletal pathologies, including:

- Gap non-union
- Infected non-union
- Limb length discrepancies
- Congenital pseudoarthrosis
- Segmental bone loss following tumor resection

Underlying Principles

The success of bone transport is rooted in several key biological and mechanical principles:

- **Law of tension-stress**: Controlled mechanical tension stimulates biological activity and new tissue formation.
- **Distraction osteogenesis**: Gradual mechanical separation of bone segments promotes intramembranous bone formation.
- **Neovascularization**: Enhanced blood vessel formation supports healing and tissue regeneration.
- **Biosynthetic activation**: Induces proliferation and differentiation of osteoprogenitor cells.
- **Intramembranous ossification**: New bone is laid down directly without a cartilage intermediary, mirroring natural bone healing.

Phases of Distraction Neo-Histogenesis

(Figs 5.1 and 5.2)

Distraction Phase

The procedure begins with a corticotomy, a low-energy osteotomy designed to preserve the periosteal and medullary blood supply, thereby creating two bone segments. The intercalary (transport) segment is gradually moved toward the other segment to fill the bone gap.

Methods of Docking

The bone segments may be docked by one of two methods:

A. Gradual Docking Method

- Rate of transport: Typically performed at 1 mm/day, divided into four increments of 0.25 mm.
- The transport segment moves toward the opposite segment until contact (docking) is achieved.
- Once docking occurs, compression is applied to stimulate healing at the junction.
- The external fixator is retained until the consolidation phase is complete.

Complications of Gradual Docking

- Fragment malalignment: Malunion or angular deformities due to inadequate control of segment movement.
- Non-union or delayed union: Often caused by interposition of fibrous tissue at the docking site.
- Soft tissue interference: Fibrous or granulation tissue may obstruct smooth segment migration.

B. Acute Docking Method

- The gap is closed rapidly, and fragments are immediately compressed at the docking site.

Complications of Acute Docking

- Neurovascular compromise: Rapid closure may cause compression or entrapment of nerves or vessels.
  - Requires intraoperative and postoperative neurovascular monitoring.
  - If deficits are noted, reversal via distraction may be necessary.
- Venous and lymphatic obstruction: May result in limb edema; managed with limb elevation.
- Soft tissue bulging: Between fixation rings, as the central segment becomes narrower during distraction.
  - A transverse skin incision is recommended to accommodate tissue shift.

Postoperative Management

Immediate Phase (Days 1–2)

- Limb elevation to reduce edema.
- Maintenance of wire-skin interface hygiene.
- Application of sterile dressings.

Early Phase (First Week)

- Active and passive mobilization to preserve joint mobility.
- Partial weight-bearing, as tolerated.
- Initiation of physiotherapy to prevent stiffness.

Ongoing Monitoring

- Regular assessment of:
  - Wire tension
  - Nut tightness
  - Dynamization of the apparatus

Consolidation Phase

Once the transport segment has successfully docked and the desired length is achieved, the distraction is halted, and the regenerate bone is allowed to consolidate. This phase involves the mineralization and remodeling of the newly formed bone.