REVIEW
OF
LITERATURE
As we know human beings carry out their profession and daily activities with the help of then efficient tools of nature i.e. Hands and Feet, even by having minute disturbances in then he is liable to suffer not only economically but also emotionally & socially.

**DEFORMITIES/TRAUMA OF HAND**

Fractures of the hand are the most frequent of all fractures. These fractures frequently involve more than one bone of hand and have intra-articular extensions, may be associated with dislocation and usually involve the soft tissue extensively. In most of these cases, conservative treatment with plaster leads to malunited fractures, unreduced dislocation and poor soft tissue care. Intramedullary fixation may lead to rotational instability, telescoping and poor fixation. External fixator at the same time achieves and maintain accurate alignment, permits soft tissue care, spares the proximal joints and cause least periosteal stripping. At present external fixation is a universally accepted technique for the treatment of fractures or dislocations of hand for prevention of subsequent deformities.

Management of long bone fractures by external fixation is in regular clinical practice since 1960’s, But the concept of external
fixation in small bones gain popularity in 1980's. Literature is scarce regarding its use in the treatment for hands and forearm injuries.

Earlier methods of external fixation in hand injuries included pin anchored in acrylic frame and small Roger Anderson metallic Frame. These methods were simple to apply but did not have stability and modularity. *Henry Jacquet (1976)* was the 1st person who developed fixation with a mini-external fixator for skeletal and soft tissue support in severe hand injuries.

*Henry Lambotte* popularized it in Britain in 1903. However due to complications related to the pin track infection at the site of insertion, the technique lost its popularity. The earlier instruments did not permit rotational and axial alignment.

*Codivilla (1905)* and *Putti (1918)* combined pins and plaster for leg lengthening. The introduction by the 1930’s of transfixion pins, longitudinal distraction and compression mechanism and universal articulations led to very sophisticated devices of *Anderson (1936)* *Stader (1937)* and *Hoffmann (1954)*.

*Dr. Hoffmann* in 1954 first produced pins with threads to achieve better purchase on bone. He also developed clamps that were adjustable, helping to correct rotation and angulation.
After World War II Ilizarov (1972) developed highly complex, but versatile ring fixator which appeared to be well suited to the correction of limb length discrepancies, malalignments and segmental transport after corticotomy.

Disksons & Crockitt DJ (1975) suggested that if the ulnar three metacarpals are all fractured, rigidity of fixation can be achieved by leaving the K-wire protruding the skin and bending them with methyl metha-acrylate and a longitudinal interconnecting K-wire strut.

Rosenburg L and Kon M (1986) and Scott M (1980) and Mulligan PJ use home made fixator with cement and rigid plastic tube for finger reconstruction and severe phalangeal fractures.

Stuchin & Kummir's (1984) laboratory comparison of various method showed that the commercial system has a clearly superior pin but greater rigidity was achieved with certain configuration of reinforced bone cement.

Howard FM (1987) used combination of tension band wiring and an external fixator for Rolando fracture. The external fixator is used to align the comminuted fragments and to restore length and tension & band wiring provide stability.

Milkford (1987) suggested mini external fixator for open or severely comminuted fractures of the phalanges.
external fixator in the treatment of multiple fragment fractures of the
base of radius and of the forearm. The external fixation can also be
used with good success. The external mini fixator is a new way for
external stabilization in the hand surgery and can provide good results
in comminuted fractures of the fingers and for finger replantation.

Schuned F, Donker Woleke M, Burney F (1984) used mini
external fixator in the treatment of 63 closed diaphyseal-metaphyseal
fractures. A simple half frame configuration was applied in the all
cases and open reduction was performed in 26% cases the mean
duration of external fixation was 30 days. There was no case of non-
union and anatomical reduction was obtained in 86% of cases. There
was no case of reflex sympathetic dystrophy. The general functional
results were very good or good in 96% and open reduction did not
significantly alter the final results. They inferred, that for treatment of
metacarpal fractures closed reduction or open reduction with
stabilization by an external fixator is a useful alternative.

Dr. Brij Bhushan Joshi of Bombay (1988) develop a simple
light mini external fixator system for use in fracture in hand. It
came to be known as JESS (Joshi external stabilization system).
Dr. Joshi used this system in more than 150 cases of crush injury of
hand involving soft tissues and bone in varying degree of severity. He
found that this assembly to be very effective in stabilizing the skeleton in functional position to allow soft tissue assessment and subsequently soft tissue healing. This system is simple and modular. This system provides tissue stabilization, spontaneous revascularization and tissue expansion by gradual and controlled distraction. Precise position of hand allows tissue transfer, tissue transplants or other reconstructions with simultaneous correction of mal alignment with joint mobilization.

Solinas S, Affani M (1989) described a new method for external fixation of phalangeal fractures. This method is not traumatic and very easy to perform. It permitted early mobilization and good healing in a series of 20 patients.

Cziffer E (1989) designed a disposable mini external fixator, suitable for either provisional or definitive fixation of hand or foot fracture. The system is simple disposable, relatively radiolucent & inexpensive. It has been listed in a human laboratory and has been used successfully in 27 cases.

Buchler et al (1991) described techniques for Rolando fractures that combine external fixation with limited internal fixation and bone grafting. He showed that in 20 displaced comminuted fractures of thumb CMC joint which were treated by external fixation, 75% of
patients have very good results after follow up for 3 years. As compared with uninvolved side, the patient achieves axial rotational average 79% radial adduction 89%, Key pinch 88%, Grip strength 81%.

*Eyres and co-workers (1993)* used Charnley compression clamp attached to transverse 2.0mm K-wires for treating various combinations of metacarpal fractures.

*Sameer I, Shehadi (1991)* used mini external fixator in difficult hand injuries after closed reduction and external fixation. In this study they exclude patients with fractures of distal phalanx, undisplaced and stable fractures and those displaced fractures, where a stable closed reduction could be achieved. The K-wire was introduced transversely at a 90° to the long axis of bone, one at the mid lateral angle and the second about 2.0mm dorsal to the first. The K-wires are then fixed externally with methyl metha-acrylate rods, made by introducing the methyl metha-acrylate, while still soft, inside clear plastic tubes slit open on the side. The open side of the tube was then applied against the free ends of the K-wires and allowed to set in 5-10 min, thus stabilizing the fracture. They utilized the plastic tubes for packing K-wires or the softener suction tubing for this purpose. Percentage return of total range of motion in phalangeal fracture varied from 66%
to 98% (mean 84%) and in metacarpal fracture it varied from 77 to 100% (mean 96%).

_Ashmead, D roth et al (1992)_ used external fixation not only for the skeletal stabilization but also for the management of soft tissue in 29 cases of acute hand injuries.

_Parson SW, Fit Zerald ja shearer (1992)_ treated complex metacarpal and phalangeal fracture by Shearer micro external fixator. This fixator consists of unpolished stainless steel rods, which may be used singly or linked by an articulating central block. The fracture may be first reduced and then fixed externally or the fixator can be applied with two rods and central block, thus allowing early joint mobilization with good or excellent function.

_Stark RH (1993)_ used mini external fixator in treatment of difficult PIP joint fractures. This article presents an alternative method consisting of close treatment of complex PIP joint fractures with a mini external fixator. The method utilizes the traction principle without necessitating a complex outrigger system. Immobilization is reduced to 3 weeks and cases presented with excellent clinical result despite sub optimal roentgenographic appearance.

_Schneider P (1993)_ used a simple external fixator of K-wire and electric clips for use on fingers.
Nagi L (1993) use static external fixation of finger fracture besides its common indication in massive, high-energy trauma and contaminated fractures. It offers true alternative to ORIF and represents a superior treatment modality in selected cases of extensive comminution.

Schmidt I et al (1995) a specific joint bridging construction make it possible to treat severe joint fractures by ligamentotaxis. Another indication is the preoperative continuous elongation treatment in severe contractures of finger. It can be made dynamic and can also be used for inter fragmental compression and distraction.

Penning et al (1995) used a mini fixator system to assist the operative correction of soft tissue contractures. The external fixator served as a tool for gradual correction and to severe joint positions after soft tissue release. Following wound healing certain fixator components were unlocked and joint mobilization initiated. The functional results in sustained grip strength reached to by 82\% compared to the uninjured opposite site.

Friker R et al (1996) showed that fracture of the hand and finger showing comminution or associated soft tissue lesions are best treated with external fixation. In contrast to other system, the new AO mini external fixator enables less bulky unilateral fixation facilitating early
mobilization and the special design of the double clamp allow preliminary intra operative stabilization with only one wire in each fragment. Out of 20 patients in their study no one developed nonunion.

*Drenth DJ, Klasen HJ (1998)* from 1982 to 1993 treated 33 patients with 29 phalangeal and 7 metacarpal fractures by external fixation using a mini Hoffman’s device. The functional results after metacarpal fractures were better than those after phalangeal fractures and fractures of the middle phalanx had better recovery than those of the proximal phalanx. 28 of the 33 patients were satisfied with their results.

*McCulley SJ, Hasting C (1999)* presented an alternative cheap method of external fixations comprising of the disposable sheath of an IV cannula as the cross bar, held by K-wires as the pins. This has been used in gunshot wound with highly comminuted fracture. The method is inexpensive, simple to use and quick to apply. Good bone length and union is achieved and stability was excellent, allowing early motion. They recommended this method when no standard fixator sets are available to surgeon.

*Salafia A, Chauhan G (1997)* used JESS for the correction of proximal IP joint deformity of hand in 68 finger cases of leprosy
patient’s. They achieved full extension in 75% of cases and good extension in 10% of the cases.

**DEFORMITIES / TRAUMA OF FOOT**

The human foot has become greatly specialized for performance of two divergent functions. Both of these functions are dynamic:

1.) In standing it must provide a stable support for body weight-balance (a passive function).

2.) In walking it must, in addition to supporting the body weight, provide a resilient spring or lever by which the body weight can be propelled forward-propulsion an active function.

These objectives are fulfilled by the architectural arrangement of a number of small spongy elastic bones grouped together in the form of series of arches. For each of the function muscle contractions are essential thus importance being greater in propulsion than in balancing.

Most of the knowledge of medicine and surgery, practiced in old time is derived from Egypt. The earliest documentation of foot disorder comes in form of wall painting and preserved writing on mummies. Paintings on the walls of the ancient tombs depict child with a clubfoot deformity and a statue of diastrophic dwarf with a clubfoot can be found in the *Tutan-Khamen* collection.
Hallus valgus consists of abnormal adduction of the proximal phalanx of the great toe towards the mid line of the foot and is associated, especially in most extreme form with varying degree of varus of the 1st metacarpal. Lapidus (1934) suggested the form “Metatarsus versus primus” to indicate a primary developmental type of entity. Lake (1942) considered varus deviation of the metatarsal as the most important factor. Kaplan (1951) described a strong contraction band extending from the tendon of tibials posterior muscle into the flexor hallucis brevis and adductor hallucis and regarded this a contributing factor. Conservative treatment consists of properly well fitting shoe. Operative treatment consists of McBride operation, Mitchell metatarsal osteotomy (1958), Keller arthroplasty, and Ross Smith arthrodesis of MP joint.

Pes Cavus or the claw foot consists of clawing of the toes combined with a raising long arch of foot. Jones and Lovett reported cause of claw foot due to polio and inflammatory infections. Ducchene originally suggested that it was due to the weakness of the short muscles of the big toe and interossii. Werton et al (1962) in a review of 629 cases of claw foot found that 25% of them had some degree of neurological involvement. Scarpynere (1945) reported congenital stricture of spinal canal. Giannestas (1953) reported right equinocavovarus foot due to intrathecal traction. Treatment includes
both conservative and operative. Conservative treatment allows the re-education of the small muscles functions by intrinsic exercise. Operative treatment include Lambrinudi operation (1927), Girdlestone tendon transfer operation (Taylor 1951), Japasmid Tarsal V osteotomy with steindler’s stripping of plantar fascia.

**CLUB FOOT**

“Club foot”, “Piede torto”, “Piebot”, “PieZambo”, “Klumpfuss” are worldwide synonyms for Talipes equinovarus a congenital deformity that has continued to plague the medical profession before the days of Hippocrates.

Archeological investigators in Mexico revealed that the Aztecs recognised clubfoot, treating it with splints made of cactus leaves.

*Hippocrates* first described clubfoot deformity around 300BC. He emphasized early and gentle treatment for the anomaly. The treatment consists of “Moulding of foot with piece of wax, applying resinous cerates with numerous bandages. In this process one should bring the parts into their natural position, both that are twisted and those, that are abnormally contracted, adjusting them in this way by hands and by bandaging in a manner so as to draw them into position gently and not violently” (*translation by Withington, 1927*).
A club foot deformity may also be acquired after birth secondary to muscle imbalance as in cerebral palsy, muscular dystrophy or poliomyelitis. Examples of this is seen in the famous painting by Spanish artist Ribera (1588-1656), "Pie-Bot" which is hanging in the Louvre museum, the subject is a boy with a right sided hemiplegia with talipes equinovarus deformity obviously a victim of cerebral palsy.

In the middle of 17th century, Arcaeus, Pares and Fabrig recommended, repeated stretching by the use of mechanical corrective apparatus, which gradually eliminated the deformity with a turn-buckle.

Scarpa in 1803 described the pathologic anatomy in "A Memoir on the congenital talipus equinovarus in Children". In this treatise he described the deformity as a "twisting of the scaphoid, Os Calcis & Cuboid around Astragalus", calling it a "Congenital dislocation of the astragalocalcanioscaploid complex". Scarpa also described the contractures of the soft parts and devised an apparatus with springs in an attempt to stretch the contractures and reduce the scaphoid.

Subcutaneous tenotomy of the achilles tendon was first performed by Lorenz, in Frankfort, in 1782.
Geurin in 1838 appears to have been the first to report the use of plaster of paris in treatment of clubfoot.

Little published a paper ‘A treatise on nature of clubfoot’ in 1839. He was Englishman and had on attack of polio at the age 4 year and his left leg was paralyzed which later resulted into talipes equinovarus deformity. He went to Germany in 1835 having read the work of Stromeyer. He also went to Honover, where Stromeyer performed subcutaneous tenotomy and corrected his deformity. During his convalescence, Stromeyer taught him how to perform this operation. Later on Little worked on clubfoot in Germany and presented a thesis for which he was awarded Doctor in Medicine in Berlin. Later on he devoted all his life to the care of crippled. He also noticed a case of pseudo muscular atrophy and presented a paper before obstetrical society of London, entitled on influence of abnormal parturition, difficult labor, premature birth and asphyxia neonatorum, on the mental and physical condition of child especially in relation to deformity. Later on above condition with cerebral palsy was called “Little’s disease”.

In 1857, Solly performed first bony operation for clubfoot, in which he removed a part of the cuboid, which was a precursor of the present day Dillwynn-Evans operation.
In 1860, Adams differentiated the acquired talipes equinovarus from the congenital variety. He also noted that head and neck of the talus were deviated medially. He felt this was a second-degree adaptive change.

Lund performed the 1st recorded talectomy for clubfoot in 1872.

In 1890 Phelps, in New York City, described a one staged medial plantar soft tissue release with lengthening of the tendons. He also performed an osteotomy of the neck of talus with wedge resection of calcaneum.

In 1898, Walshingham & Hughes renewed interest in theory that the deformity was due to a germ plasm defect of the head of talus. They reported osteotomy of talus as a means of correction.

In 1906 Codvilla from Italy described a soft tissue release with lengthening of tendons, including the anterior tibial. He advocated soft-tissue surgery should be done when a child is about 3 years of age.

In 1930, Kite popularized non-operative treatment with serial manipulation and plaster cast immobilization.

In 1934 Denis-Browne renewed interest in mechanical intrauterine pressure as cause of the deformity. He advised forceful
manipulation before application of his splint which fallen into disrepute because it caused deformity of bones and stiffness of joints.

*Leo Mayer (1934)* assessed that Equinus position of OS calcis is extremely difficult to correct, for which he devised a method which consisted of inserting of a nail or wire through posterior portion of OS-calcis by means of which, following tenotomy and posterior capsulotomy, the posterior portion of OS-calcis can be pulled downward and anterior portion upwards. A six weeks period of immobilization was employed.

*Shin Movita & Kyoto in 1962* devised a method for treatment of resistant clubfoot deformities in children up to 6 years of age. After heel cord lengthening, occasionally combined with posterior capsulotomy, leverage wire traction is applied directly to calcaneus by means of K-wire and padded foot plate, both of which are incorporated in plaster cast between manipulation. After correction of equinus and varus deformity of heel, the wire is removed and subsequent correction is completed by manipulation and plaster casts.

*Prof. Gavrill Abramovich* devised an external fixator in 1951 in Russia. He advocated the use of ring fixator in correction of the deformity in CTEV. By applying the fixator, not only the bone but
also the muscles, nerves, blood vessels and tissue grow simultaneously.

*Grill & Franke (1987)* noticed importance of the discrepancy in length between the medial and lateral border of foot in correction of the deformity and achieved continuous distraction by external fixator.

*Cantine et al (1990)* presented management of relapsed clubfoot and other severe foot deformities with the Ilizarov external fixator. He reused it on 14 feet in 13 children aged 2-16 years. It included 8 idiopathic relapsed clubfoot and 6 severely deformed feet secondary to teratogenic or neurological anomalies. Plantigrade and functional foot was obtained in all of idiopathic clubfeet and in 2 of the teratogenic deformed foot.

**At the present scenario, JESS has been develop by, Dr B B Joshi in Mumbai, India in 1988.** Today it has evolved into a sophisticated system with applications in trauma, defects and deformities in the upper and lower extremities. It has a special application in the correction of clubfoot resistant to conservative management. The principle of fractional distraction as popularized by Ilizarov in 1980, is the basis of correction of deformity. Dr. Joshi added the concept of differential distraction to this basic principle. In differential distraction the concave side of the deformity is distracted
at twice the rate of the tissues on the convex side, lengthen the limb and effectively corrects the deformity at the same time. He presented this technique at the first international conference on clubfoot at Milwaukee (USA) in 1990. This method is an extension of conservative method with osseous holds. Since only soft tissue stretching is involved, the corrected foot is supple than the operated cases. Over correction is usually not seen except for the cases, which Turco calls atypical TEV. This is avoidable by weekly inspection, we can stop distraction at that stage if it does occurs, it can be reversed by prolonged immobilization to allow the tissues to fall back, as any tissue which can be stretched has got the capacity to shrink in proper environment. It has a shorter learning curve than an open surgical procedure, which require more skills to get full correction and demands cutting of many tissues to secure bony alignment. JESS frame is designed to provide simultaneous three-dimensional correction of this deformity. It has been widely used in resistant, recurrent and neglected deformity with success. Dr. Joshi has made India proud. Awards and recognition for his work are numerous. Amongst his most recent are the Indian council of Medical Research Award (1986) and “A best Citizen of India Award” in 1998.