The Use of Distraction Techniques in Treating Radial Club Hand
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Abstract
Radial club hand is a complex anomaly and requires customised approach. Distraction techniques are useful as alternative and adjunctive procedures in various stages of management of radial club hand. The main use of distraction is to lengthen the ulna and correct its deformity and distraction prior to centralisation of hand reduce tissue dissection. Distraction can also be used as a precursor to microvascular joint transfer, to correct residual deformities in radial club hand and as an adjunct to the operation of ulnarization. The present article details the use of distraction techniques in radial club hand and provides insight into its principles based on authors experience.
Keywords: Distraction, radial club hand

Introduction
Radial club hand or radial hemimelia is a difficult congenital anomaly to treat. There is a severe manus valgus deformity at the wrist due to a partial or complete absence of the radius. Movements of the elbow and interphalangeal joints of fingers are restricted. There is a high incidence of aplasia and hypoplasia of the thumb [1,2].

Treatment aims to correct deformity at the wrist to improve the appearance and hopefully the function as well. Untreated patients adapt well to the deformities and have reasonable function. The shortened forearm and deformed wrist are unsightly. Distraction techniques help lengthen and correct deformities of the bones. Distraction lengthens the shortened and deficient soft tissues as a precursor to centralization of the wrist. External fixation and distraction help assist Ulnarization of the wrist.

For lengthening & deformity correction of the bones
The condition occasionally presents itself as a shortening of the Radius. Distraction lengthening of the distal radius equalizes length to that of the ulna to match it at the distal radial ulnar joint [3,4]. Though uncommon, it is the simplest of all treatment modalities(Fig1). A monolateral fixator is easy to use with two half pins in the proximal and distal fragment each. An angulation translation osteotomy corrects the bowing deformity of the proximal ulna. A large deformity can be corrected percutaneously. In this situation, it is better to perform the surgery using the Ilizarov external fixator. A 5/8 th ring fixed proximally at the elbow is kept open anteriorly to allow flexion of the elbow joint. The distal ulnar ring can be a full one.

The hand is fixed with a ring with wires and half pins. Distraction in the concavity corrects the radial deviation deformity. The hand ring also prevents deformities that may arise with distraction.

Deformity at the carpus can be corrected with an angulation-translation osteotomy of the distal ulna without resorting to open surgery. Ulnar bow is corrected by angulating the distal ulnar fragment with medial translation. This helps buttress the wrist and improve the appearance of the hand. (Fig. 2)

Lengthening of the radius equalizes radio-ulnar length in acquired clubhand due to growth arrest. The aim is to correct the length deficit as well as angular deformity of the lower end of radius and to try and match it to the distal ulna [5,6]. The physeal arrest must also be addressed on its merits and a physeal bar resection must be performed.

The use of distraction techniques as a precursor to Centralization
Deformity correction by centralization is popular and the aim is to get the ulna to be collinear with the lunate, capitate and third metacarpal. Extensive soft tissue release with resection of the capsule is needed to get the carpus in line with the ulna. The deficiency of the soft tissues as well as skin on the radial side makes this a difficult task. Many have also described the role of pre-centralization distraction. It is an attractive concept as it may help reduce the extensive soft tissue dissection needed to get the carpus on top of the ulna.
The soft tissue deficit causes radial deviation and ulnar subluxation of the wrist. Gradual distraction of the soft tissues doesn’t merely stretch them but lengthens them according to the law of tension stress [7]. A monolateral or circular external fixator is applied to the hand and ulna. Soft tissue elongation allows the hand to be distracted out of radial deviation & volar subluxation to enable the third metacarpal to become collinear with the ulna [8,9,10,11,12]. The external fixator retains the lengthened position till soft tissues mature & prevents reshortening. This may reduce the extent of soft tissue dissection needed to achieve correction. A K wire travels from the third metacarpal going down into the capitate, lunate and ulna. Some prefer to remove the K wire at 12 weeks and retain the correction by either tendon transfers or a brace. Some prefer to leave the K wire in situ. The K wire may be passed without making any preparatory changes in distal ulna. External fixation corrects the deformity maintains the position thereafter. The distal ulna flattens out to match the surfaces of the carpus. Preserved movement and improved appearance gives a good cosmetic and functional result.

The external fixator maintains position and stabilizes the wrist. Some surgeons create a notch in the proximal carpus and insert the distal ulna in it. The notch behaves like a multiplane joint to allow movement and prevents recurrence of deformity.

Distraction techniques as a precursor to Microvascular joint transfer
There is a complete deficit of the radial side of the wrist. Any positioning of the carpus on the distal ulna is therefore unstable. Distracting the carpus out of radial deviation and volar subluxation creates space on the radial side of the wrist. Microvascular technique is used to fill this space with the second metatarsal and metatarsophalangeal joint transfer. The bone is fixed to the ulna in a Y shaped manner [13,14]. The advantage of this method is that a proper joint is created and buttress support to the radial aspect of the wrist is permanent. However, long term studies are lacking on how these transfers perform. The microvascular technique itself is rather complex and such skills may not be available at all centres which makes their application rather limited.

Distraction techniques to correct residual deformities in Radial Clubhand
A common complication of centralization is recurrence of the deformity. Since K wires are removed after a few weeks (or may migrate proximally), recurrence of the deformity is likely due to re-shortening of the fibrotic and inelastic soft tissues. The extensive dissection of the distal ulna may damage its blood supply and result in distal ulnar growth arrest with deformities and shortening. In these situations, a circular...
fingers stiffness of the wrist can contribute to functional movements in the elbow and PIP and DIP joints of the hand eventually need an arthrodesis. Combined with the restricted movement at the wrist even without subluxation deformity of the wrist is common.

Creating a notch in the wrist with residual deformity may help achieve a fusion of the wrist. Maintaining the hand forearm angle for long term hand function [18]. However, fingers are usually stiff to start with and cannot be influenced by surgery. Centralization or radialization reduces movement at the wrist even without fusion. Recurrence of the radial deviation and volar subluxation deformity of the wrist is common.

Distraction as an adjunct to the operation of Ulnarization. Wrist and finger movement are more important than maintenance of hand forearm angle for long term hand function [18]. However, fingers are usually stiff to start with and cannot be influenced by surgery. Centralization or radialization reduces movement at the wrist even without fusion. Recurrence of the radial deviation and volar subluxation deformity of the wrist is common.

Creating a notch in the wrist with residual deformity may eventually need an arthrodesis. Combined with the restricted movements in the elbow and PIP and DIP joints of the fingers stiffness of the wrist can contribute to functional disability.
distal forearm allowing the distal ulna to slide from the
dorsum of the wrist towards its radial aspect. Care is taken to
prevent subluxation of wrist and hand on the volar or dorsal
side of distal ulna. It is fixed to the hand and wrist with a K-
wire for a few weeks. Ilizarov fixator fine tunes position of
the hand and wrist on the distal ulna. It may also be used for
an osteotomy of the proximal ulna if grossly deformed. The
distal ring is distracted to improve the tension in the soft
tissues and transferred tendons.

Prominence of the distal ulna on the radial side of the wrist
looks like a prominent radial styloid. The appearance of the
entire forearm and hand is dramatically improved. The FCU
is transferred to the dorsal ulnar side of the wrist to the base
of the fifth metacarpal. The wrist can dorsiflex due to
transferred action of flexor carpi ulnaris. Muscles on the
radial side of the wrist are usually absent and unavailable for
tendon transfers.

The author has performed five procedures in four patients
over the last seven years. Age has ranged from 2 to 18 years
of age. Follow-up has now ranged from a period of three
to eight years. A short period of bracing or casting was
needed in two of our cases. The improved appearance of the
hand was satisfactory for all of our patients. There was a mild
recurrence of the volar flexion deformity at the wrist in 2 of
five patients. There was very little recurrence of radial
deviation deformity. Three had aplasia of the thumb for
which they have not yet come for pollicisation. Poor hand
function has been chiefly due to lack of the thumb and
stiffness of the fingers.

Conclusions

Distraction techniques using monolateral and Ilizarov external
fixators have an important role in the treatment of Congenital
Radial club hand. They help lengthen the short radius and the
shortened ulna along with deformity correction of the ulna either
at the proximal or distal level. They ease the operations of
centralization of the wrist by reducing the need for extensive soft
tissue distraction. Recurrent deformities are easily corrected by
distraction techniques. It aids displacement of the carpus to the
ulnar border of distal ulna in Ulnarization. This procedure
improves appearance of the hand by correcting the deformity,
preserves its recurrence but preserves the mobility of the wrist.

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