

# Radialization With Ulnar Cuff Osteotomy: A Technique for Deformity Correction in Radial Longitudinal Deficiency

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Various procedures described for deformity correction in radial longitudinal deficiency (RLD) have encountered problems of stiffness, instability, and inadequate correction. Many surgical modifications of these procedures have still resulted in deformity recurrence, shortening, and damage to the epiphysis. To align the hand with the forearm, the deforming forces from both soft tissues and skeletal growth should be addressed without damaging the ulnar epiphysis or the carpus. To achieve this, we propose a metaphyseal ulnar cuff osteotomy during radialization. After soft tissue release, the overlap of carpus to ulna is shortened at the metaphysis in the form of a subperiosteal cuff along with additional tendon balancing. This procedure has helped us in correcting the deformity without damaging the epiphysis or the carpus and has maintained correction through the initial critical growth period of the child. (*J Hand Surg Am.* 2018;43(3):293.e1-e7. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

**Key words** Centralization, radialization, radial longitudinal deficiency.



**R**ADIAL LONGITUDINAL DEFICIENCY (RLD), a relatively common congenital deformity (0.2–0.5 in 10,000 live births) is characterized by radial side hypoplasia or absence.<sup>1</sup> In most cases, the alignment of hand is almost perpendicular to the forearm, leading to overall shortening, unsightly appearance, and reduced hand function. Centralization, radialization, and suggested modifications have been described to correct this deformity and restore the alignment of the hand with the forearm. However,

these modifications frequently result in compromised hand function with recurrence of deformity.<sup>1–4</sup>

Centralization of the ulna has resulted in a less functional wrist owing to fusion of the distal ulna with the carpus and a reduced forearm length owing to shaving of the distal ulnar epiphysis. Deformity recurrence remains high.<sup>2</sup> The problems of a stiff wrist have been resolved to a degree by performing an un-notched centralization with adequate tendon transfers to maintain the wrist in position. Radialization was a landmark procedure aligning the forearm with the index finger metacarpal and so addressing the imbalance between the moment arms.<sup>5</sup> Residual tight radial structures have led to recurrences even with this procedure.<sup>4</sup> We propose the ulnar cuff osteotomy to overcome the tight radial tether. It involves shortening of the ulna, which relaxes these structures during the growing period, reducing recurrence after deformity correction. It diminishes the imbalance between the moment arms and also minimizes damage to the

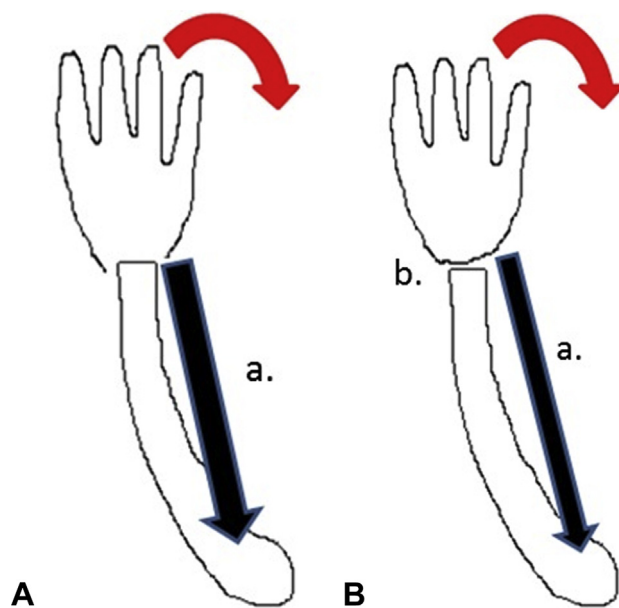
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Received for publication July 2, 2017; accepted in revised form November 16, 2017.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/18/4303-0024\$36.00/0  
<https://doi.org/10.1016/j.jhsa.2017.11.012>



**FIGURE 1: A** Notched centralization. The black arrow (a) represents the tight radial structures causing recurrence in the absence of tendon transfers. **B** Nonnotched centralization. Tight radial structures (a) cause instability in the absence of notching and tendon transfers. Red arrow in both images shows the direction of instability.

epiphysis or carpal bones, thus preventing stiffness and growth arrest.

### INDICATIONS

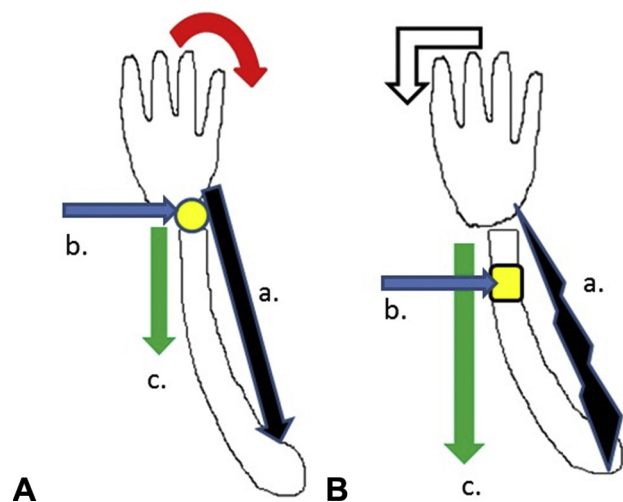
1. Radial longitudinal deficiency classified as Bayne and Klug type III or type IV.
2. Radial longitudinal deficiencies with moderate severity that can be corrected passively to a neutral position without preoperative distraction.

### CONTRAINDICATIONS

1. Children with mild deformity that can be passively manipulated to neutral and beyond.
2. Children with severe associated cardiac anomalies and with life-threatening syndromes who are unfit for the surgical procedure and anesthesia.

### SURGICAL ANATOMY

In RLD, the preaxial structures on the radial side of the forearm and hand are deficient. The radius may be either hypoplastic or completely absent. The radial angulation is mostly due to the presence of radial soft



**FIGURE 2: A** Classic radialization. The black arrow (a) shows the residual tightness on the radial side of the forearm. The blue arrow (b) shows the excision or manipulation done at the carpus or the radial epiphysis level. The green arrow (c) in both images shows the tendon transfers done to shift the moment arm to the ulnar side. The red arrow shows potential for recurrence owing to taught radial soft tissues. **B** The ulnar cuff osteotomy where a cuff of metaphyseal bone is resected (b). This results in shortening of the ulna, but it helps in reduction of the residual tightness on the radial side (a).

tissue tethering and taut flexor tendons. The extensors carpi radialis longus and brevis in most of the children are absent or may be fused with the extensor digitorum communis. The extensor carpi ulnaris (ECU) is the one tendon that is always present in these children. The flexor digitorum superficialis usually is present and may be abnormally tight compared with the flexor digitorum profundus. The pronator quadratus, extensor pollicis longus, abductor pollicis longus, and flexor pollicis longus muscles usually are absent (Fig. 1).

As the child grows, there is a mismatch of soft tissue structures and skeletal length in the forearm. Radial side deviation increases due to tight soft tissues and the ulna bows. This mismatch of soft tissue versus skeletal length has been surgically overcome by shaving the distal ulnar epiphysis or creating a notch in the carpal bones. However, if the cartilage of the distal ulna is shaved in excess to flatten the surface or if a carpal bone is excised to accommodate the distal ulna, it leads to intercarpal fusion, a stiff wrist, and later growth disturbances. Buck-Gramcko<sup>5</sup> also described treating the carpus in this manner in some of his cases to achieve the correction. Hence, our hypothesis for the new technique is to shorten the

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