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(CASE REPORT)

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Allografts: Hand, wrist and forearm

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Abstract

Bone defects are a very common problem in hand surgery and in wrist surgery. Bone allografts may be used instead of autologous bone graft to avoid donor site morbidity. Flexor and extensor tendon injuries significantly impact a patient's quality of life, resulting in significant functional deficits; soft tissue allografts may be used instead of autologous grafts as well.

Keywords: Bone allograft; Soft tissue allograft; Hand and wrist trauma; Hand extensor/flexor trauma; DBM Putty

1. Introduction

The use of allografts (hard, soft and DBM Putty) has become a vital option for orthopedic surgeons in the treatment of a variety of musculoskeletal lesions [1-3]. They are used in a number of procedures to save lives, repair limbs, relieve pain, or improve a patient's quality of life. Bone graft allografts must provide scaffolding for osteo-conduction. The advantages of using soft tissue allograft tissue include a lack of donor site morbidity, high tensile strength, decreased surgical time, smaller surgical incisions and a low risk of arthrofibrosis [4-7]. Demineralized bone matrix (DBM) is produced by acid extraction of allograft cortical bone. DBM contains non-collagenous proteins: type 1 collagen, which provides the osteoconductive scaffold for osseous in-growth; and osteo-inductive growth factors that include BMPs, fibroblast growth factor, insulin-like growth factor, platelet-derived growth factor, and TGF-β. These properties make DBM both osteoconductive and osteo-inductive [8][9][12][13].

2. Patients treated with bone allografts

2.1. Case 1

A.B., Male, 37 years old – Non-union 7 years after ulna fracture treated with 6 holes plate. (Fig. 7 B)

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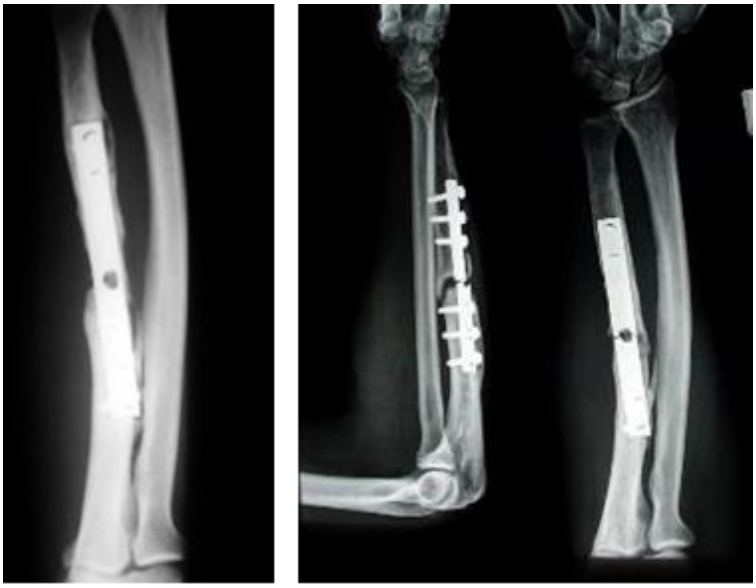

Figure 1 A - 4 years post-op., B - 7 Years post-op.

2.1.1. Treatment

Plate removed and a new 6 holes plate positioned. Non union debridment and grafted with DBM putty and cortical cancellous chips. (Fig. 2 A – B)

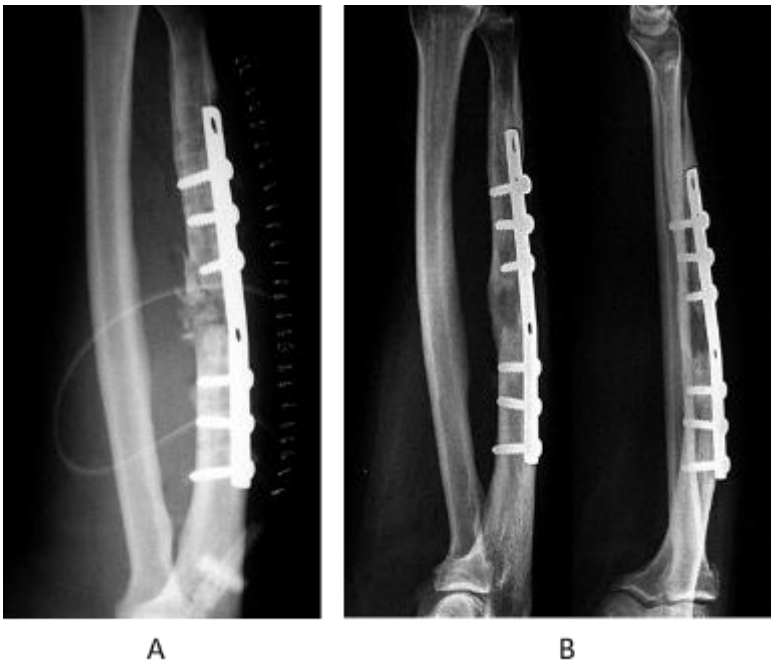

Figure 2 A – B: 6 months post-op.

Uneventful post-operative course.

2.2. Case 2

M.B., Male, 17 years old – Non-union after 4 months post op. (Fig. 3)

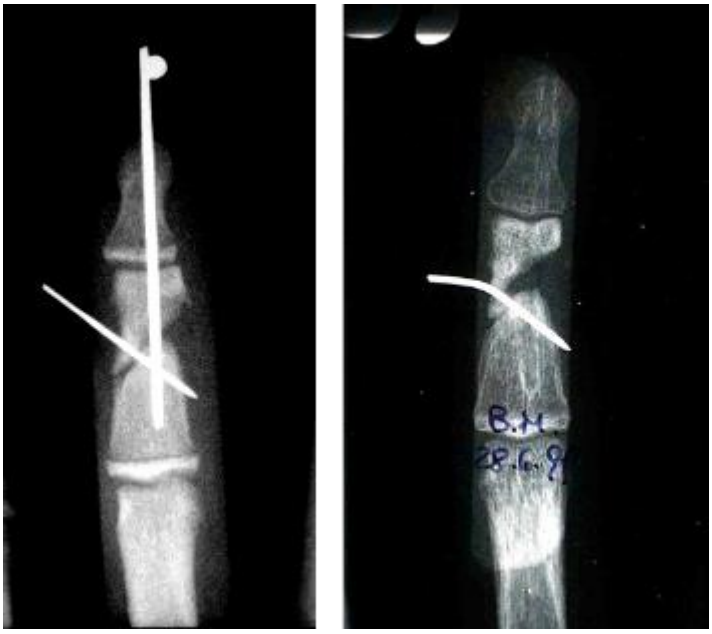

Figure 3 4 months post-op.

2.2.1. Treatment

Non-union debridement and grafted with DBM putty and cortical cancellous chips. Fig. 4 – 5)

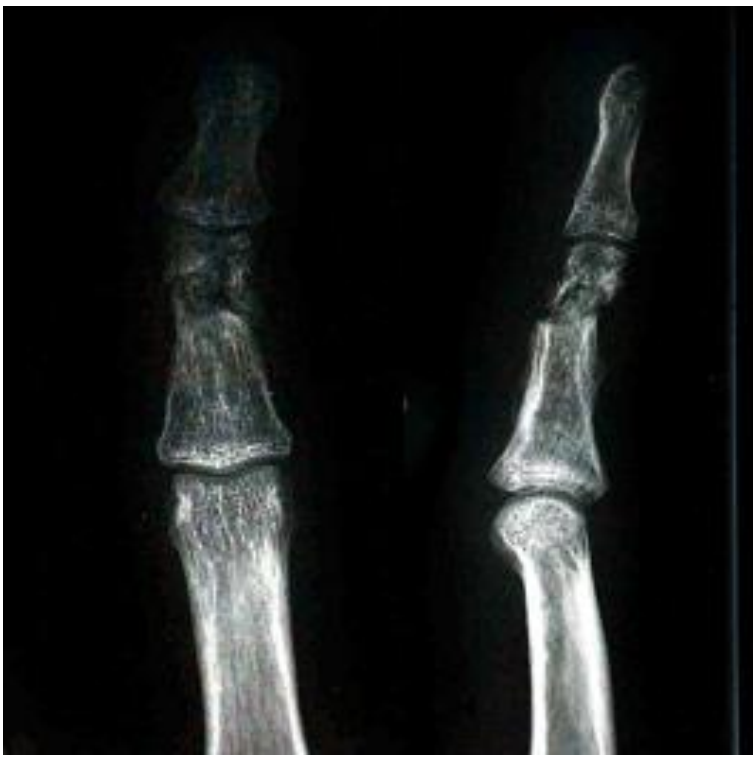

Figure 4 Post-op. control

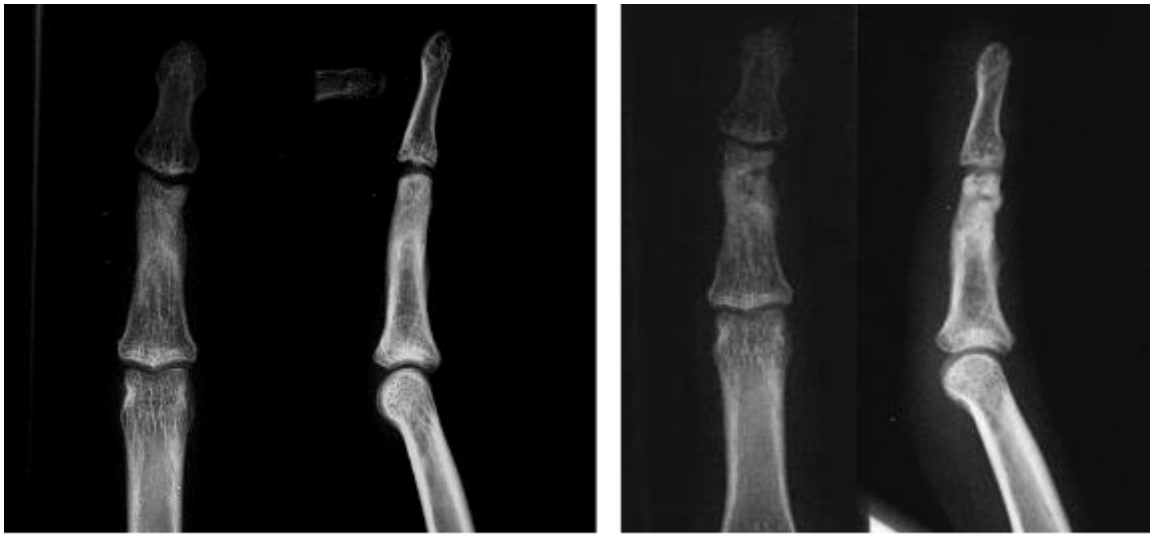

Figure 5 A, 2 months post-op, , B, 8 months post-op

Uneventful post-operative course. (Fig. 5 A – B)

2.3. Case 3

M.G. 23 years old – Scaphoid non-union 8 months post-op. (Fig. 6)

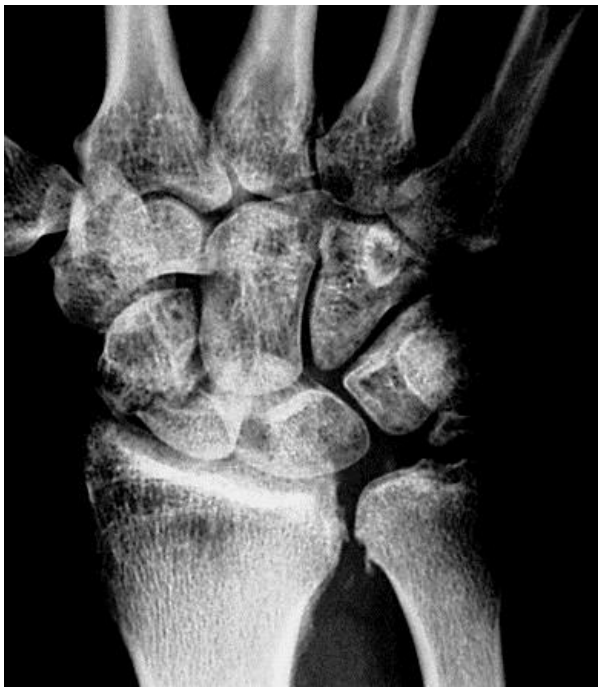

Figure 6 8 months post-op.

2.3.1. Treatment

Non union debridement and grafted with tricortical ilium strip and Herbert screw. (Fig. 7 -8)

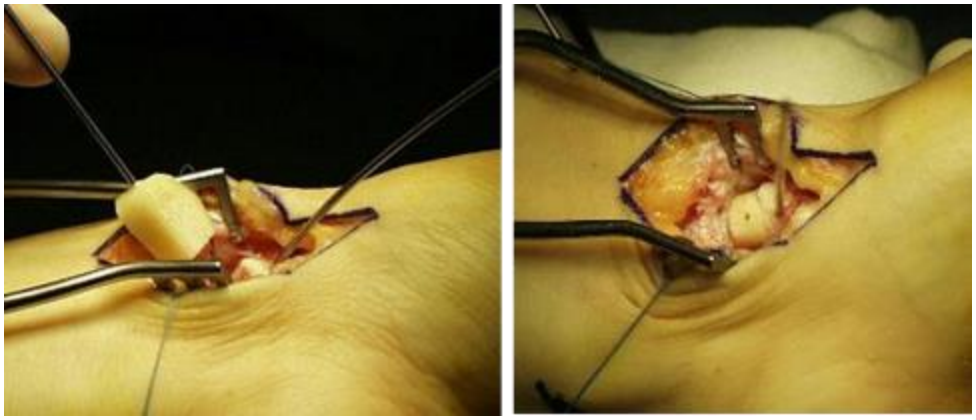

Figure 7 Tricortical ilium strip graft

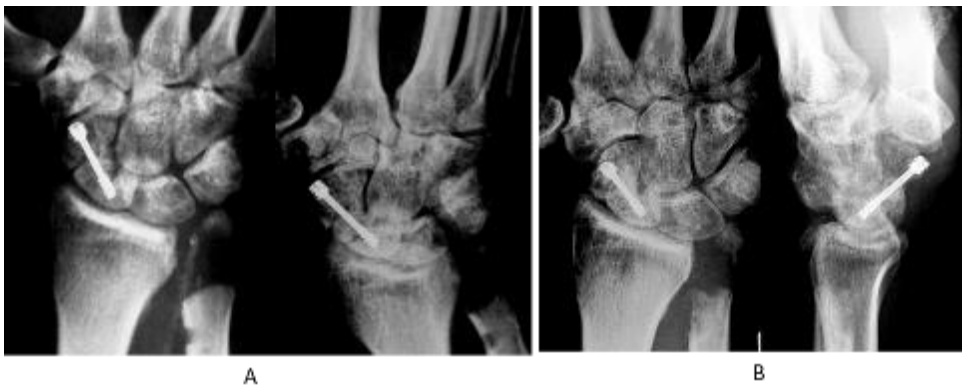

Figure 8 Herbert screw. A - Post-op. control, B - 3 months post-op

Uneventful post-operative course.

2.4. Case 4

G.S., 29 years old – Radio and ulna fracture with bone loss. (Fig. 9)

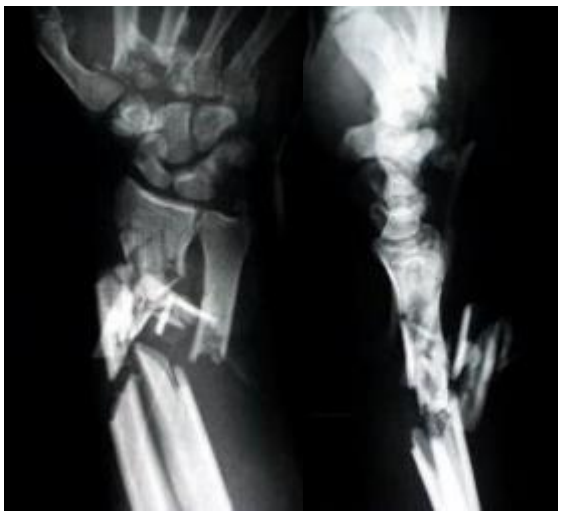

Figure 9 Pre-op

2.4.1. Treatment

Fracture reduction and plated. At 3 months post-op. insufficient bone regeneration. It was decided to fill the bone loss with DBM putty and cancellous chips. (Fig. 10 A – B – C - D)

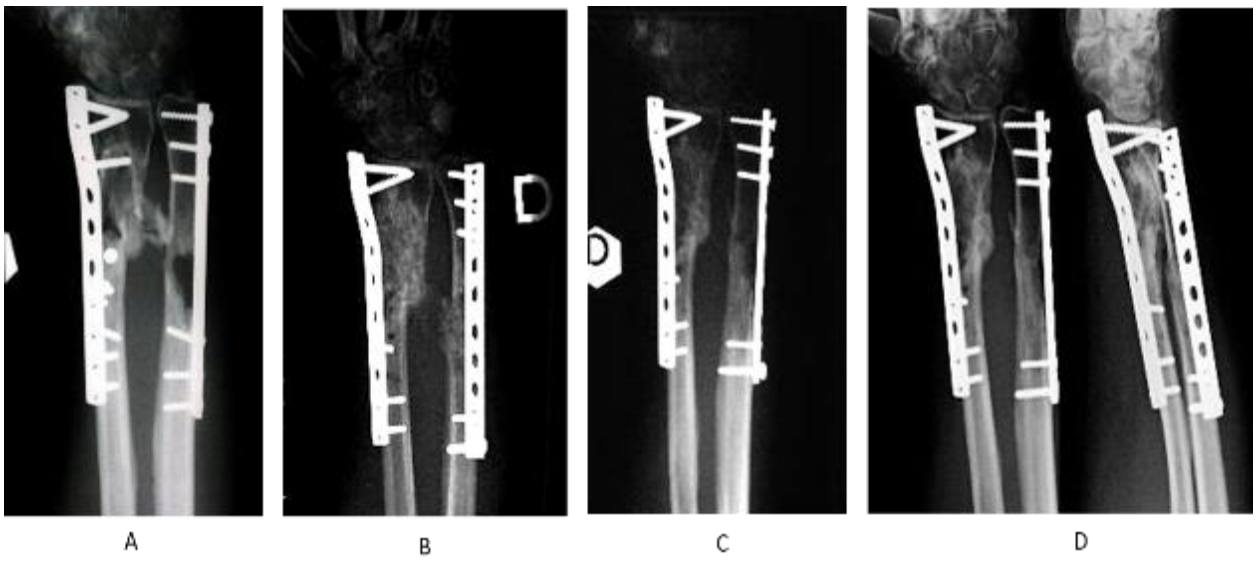

Figure 10 A - 3 months post-op, B - Post-op. control, C - 3 months post-op., D - 6 months post-op.,

Uneventful post-operative course.

2.5. Case 5

M.B. 34 years old – Bone loss

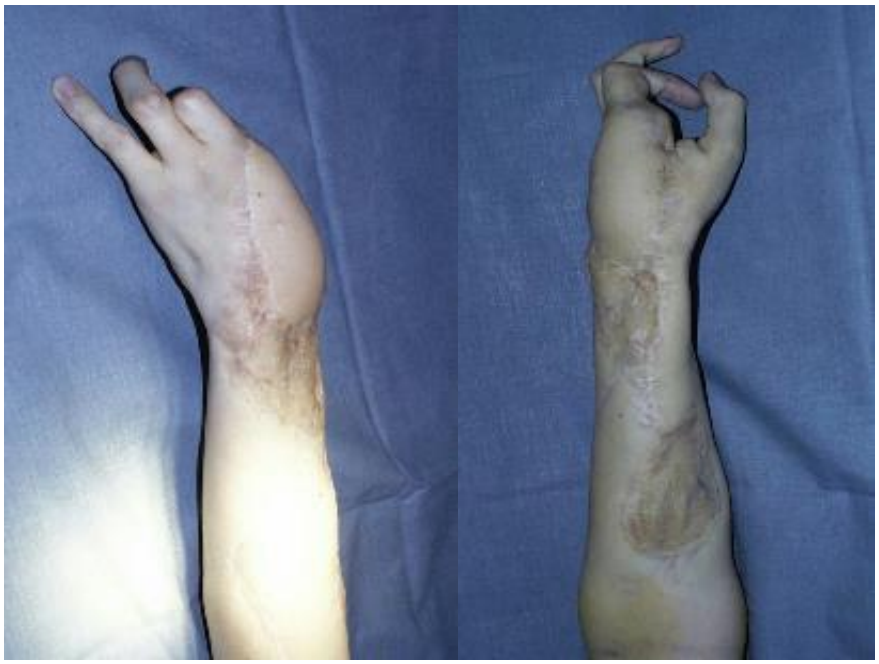

Figure 11 After skin graft

2.5.1. Treatment

Peroneal shaft graft. At 3 months K-wires were removed. (Fig. 12 A – B)

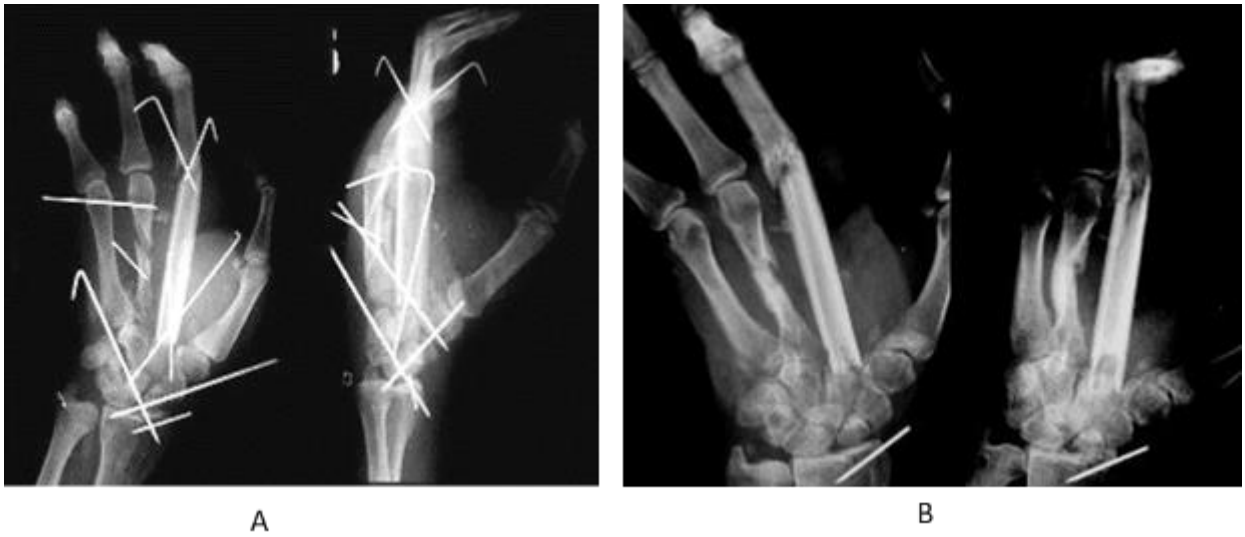

Figure 12 A - 2 months post-op, B - 2 months post-op

Good stability at 14 months post-op.

2.6. Case 6

C.F. 44 years old – Bone loss Fig. 13)

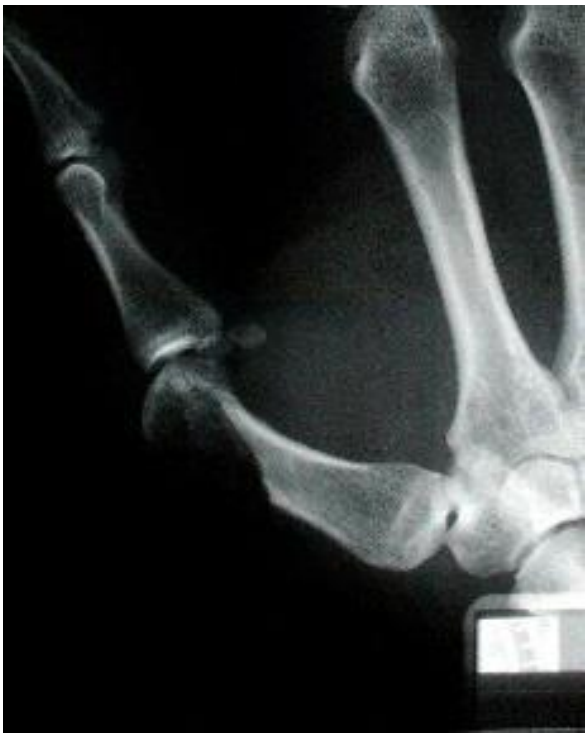

Figure 13 Pre-op.

2.6.1. Treatment

Grafted with DBM putty and cancellous chips. (fig. 14)

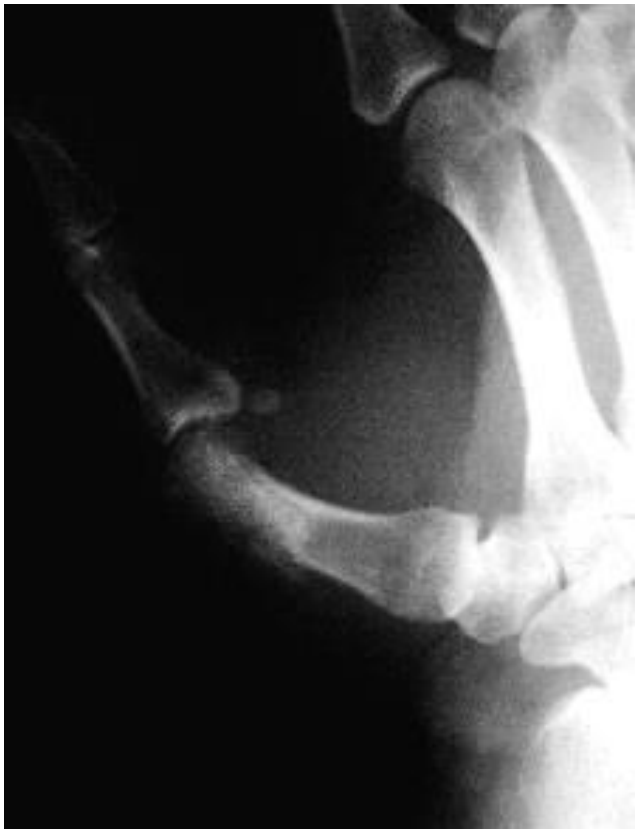

Figure 14 Post-op. control

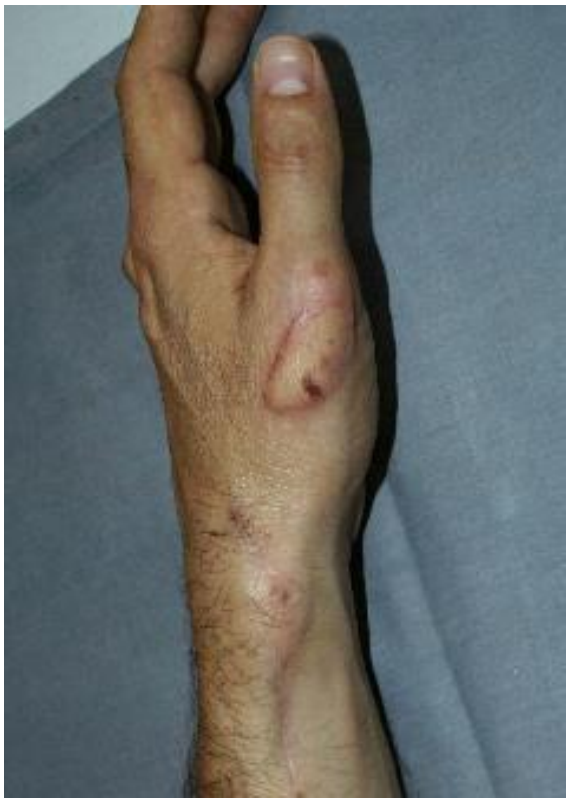

Figure 15 4 months post-op.

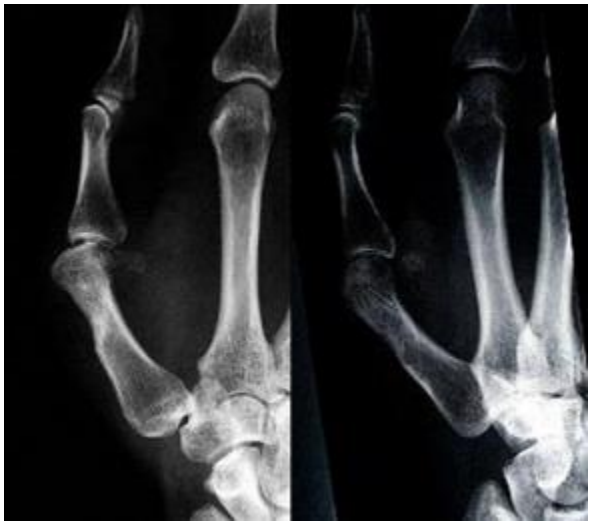

Figure 16 4 months post-op.

Uneventful post-operative course. (fig. 15 – 16)

3. Hand flexor/extensor injuries treated with acellular dermal matrix

Injury causing the rupture or laceration of the flexor tendons of the fingers often requires surgical intervention. This tendon and pulley system works in conjunction to maximize efficiency and to avoid a "bowstring" effect of the flexor tendons that can cause noticeable losses in finger strength, motion, and flexion. Consequently, the tendon-pulley system plays a vital role in normal hand function. Several different biomaterials exist, primarily autografts and allografts, that can act as substitutes or augments to the pulley system. However, autograft use comes with several disadvantages including second surgical site morbidity, increased patient pain, and limited graft material. An alternative treatment for injury of the finger flexor tendon is a matrix scaffold for new tissue generation, an acellular human dermal matrix (ADM) allograft as reviewed by Wainwright and Bury.[10] Decellularized human skin has been used for a variety of medical procedures, primarily involving wound healing, soft tissue reconstruction, and sports medicine applications. [11][13].

3.1. Case 7

B.G. , 16 years old

Injury to the flexor digitalis profundus (DP) close to distal insertion on the left hand. The flexor digitalis superficialis was intact. (Fig. 17)

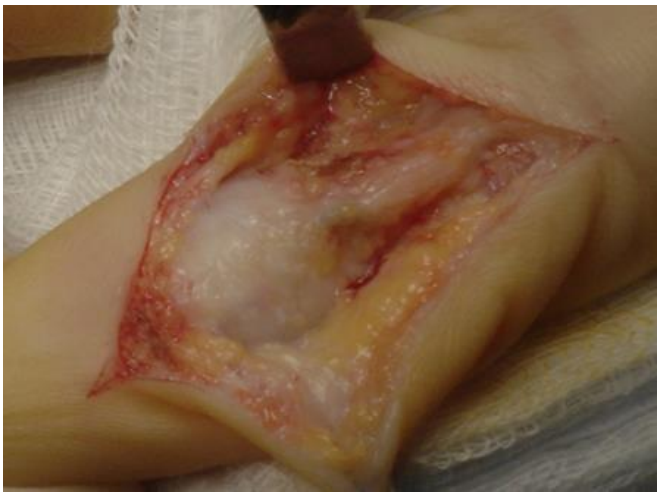

Figure 17 Provide appropriate detail caption to the figure.

3.1.1. Treatment

A palmaris longus tendon graft was sutured with Prolene 4/0 (to the distal stump of the FDP and to the proximal end of a silicone rod to be passed through the digital canal due to the thinness and inconsistency of the graft, a strip of 4cm x 4cm non-meshed Dermacell was used to augment the suture site. (Fig. 18)

Dermacell was trimmed to the size of the A4 pulley and sutured with Prolene 4/0 stitches. (Fig. 19)

Short arm splint was applied for 4 weeks with the wrist in 30° flexion and early protected active ROM was allowed.

Rehabilitation program continued 4 additional weeks.

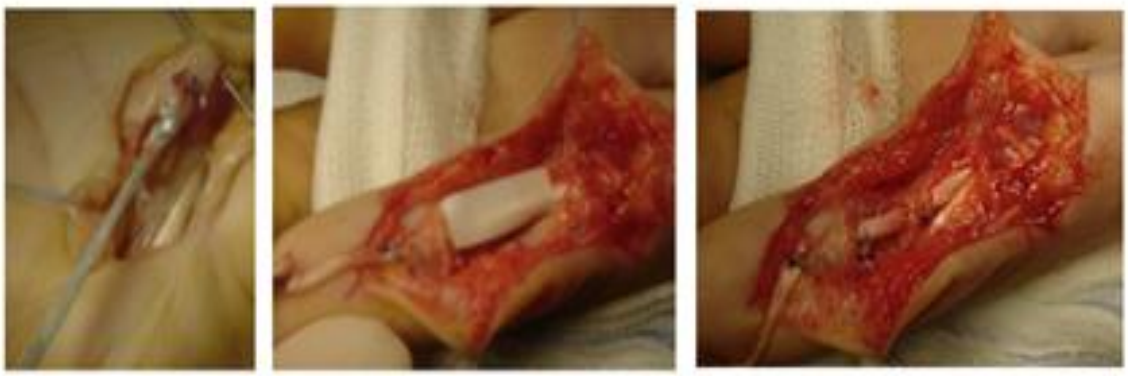

Figure 18 Distal fixation augmented with ADM

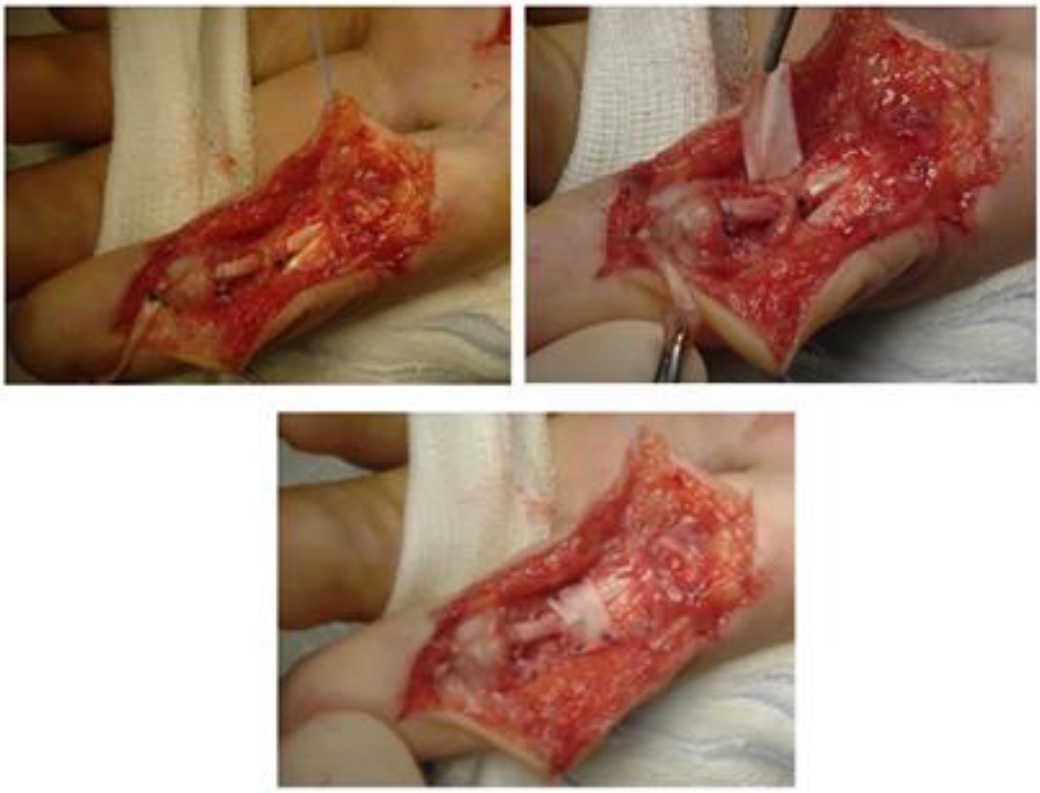

Figure 19 Pulley A4 augmented with ADM

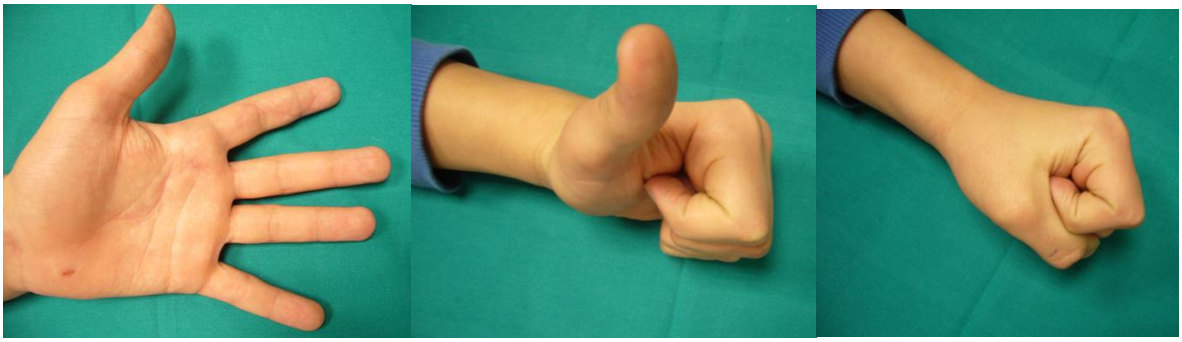

Figure 20 6 months post-op

Postoperative course was uneventful: no swelling andno adhesion were observed.

By 6 months post-op, the patient regained active 10° to 60° ROM. Fig. 20)

Excellent augmentation of the flexor tendon repair was achieved along with restoration of the pulley system.

3.2. Case 8

S.A., 40 years old

- Open crushing injury over the dorsal aspect of the middle finger of his left, non-dominant hand during a car accident three years earlier. Dorsal skin, the extensor apparatus at both the proximal and middle phalanges, and the proximal interphalangeal joint (PIP-j) were injured. The patient presented 8 months after the injury with a large attenuated scar over the dorsal aspect of the finger that maintained the PIP-j in full extension. After resection of the scarred skin, a gap was found in the extensor apparatus just proximal to the PIP-j. Skin coverage was achieved by using a dorsal inter-metacarpal pedicled flap and direct extensor tendon repair was performed. Prolonged FKT was unable to restore PIP-j joint flexion and radiographic signs of joint degeneration were evident 2 years thereafter. Total PIP-j replacement was performed with a Pyrocarbon implant, resulting in severe extension lag. Six months later it was decided to perform extensor tendon reconstruction. (Fig. 21)

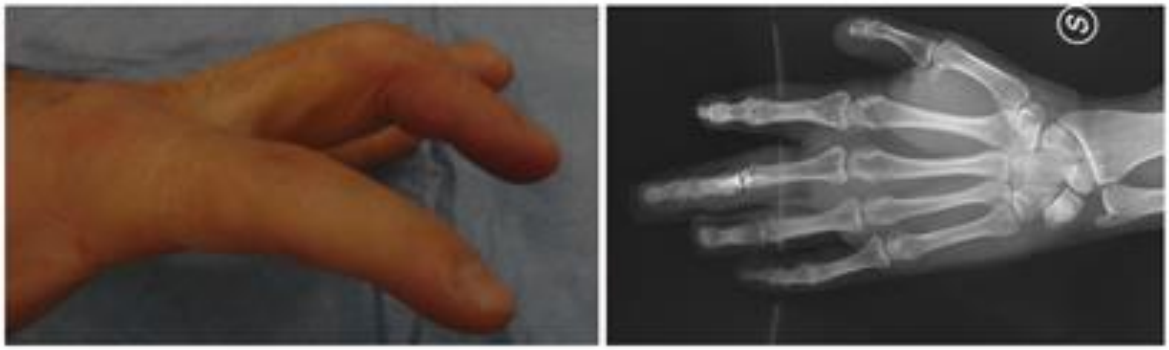

Figure 21 Pre-op.

3.2.1. Treatment

The limb was exsanguinated, and the tourniquet inflated to 230 mmHg. A curved incision was performed over the dorsal aspect of the PIP-j. The extensor tendon was mobilized, and the elongated scar was found close to its insertion onto the middle phalanx. After resection of the scar tissue, a 15 mm gap resulted. Tendon repair was performed by an Ethibond 2-0 core suture, reinforced with a Prolene 4-0 running stitch. Due to the poor quality of the tendon, the repair site was augmented with a 4x4 cm of Dermacell (*LifeNet Health, Virginia Beach, VA, USA*) strip, overlayed over the repair site and secured with Prolene 4-0 interrupted sutures. Fig. 23 – 24). The finger was splinted in slight flexion for 2 weeks and an early rehabilitation program started. A progressive increase to maximal flexion was allowed over the following 4 weeks. Augmentation with Dermacell proved to be an effective option for extensor tendon reconstruction. Dermacell's

mechanical resistance to suture pull-out along with its pliability and thinness, make it the first choice for this challenging procedure.

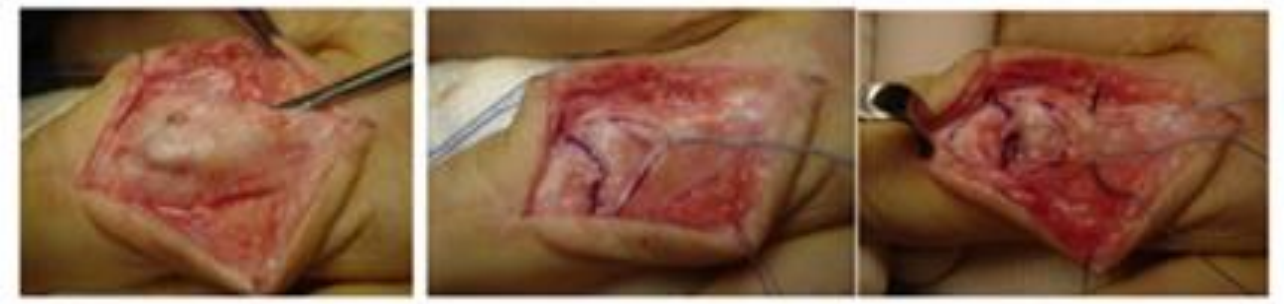

Figure 22 Tendon repair

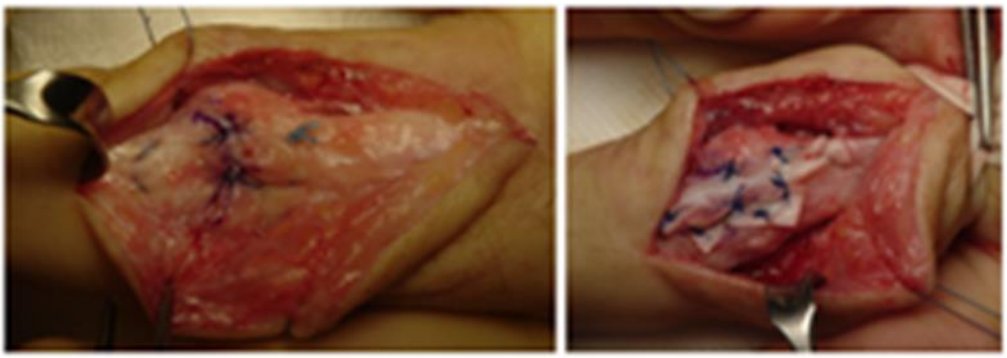

Figure 23 Tendon repair and augmented with ADM

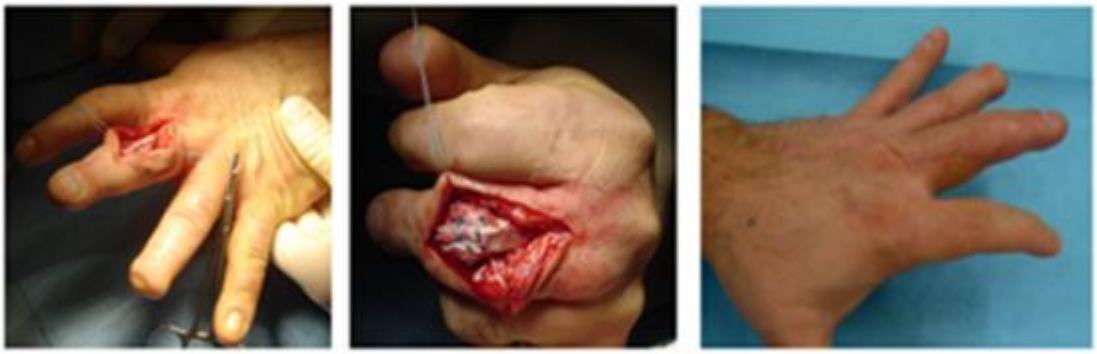

Figure 24 A Intra-operative extension/fexion check, **B** 3 months post-op

Excellent augmentation of the extensor apparatus at the PIP-j was achieved. Postoperative course was uneventful: no swelling or adhesion were observed that would alter the finger shape. 3 months post-op, the patient regained 10° to 90° ROM.

4. Discussion

Allograft bone is a good substitute for bridging bone defects for patients with trauma. In contrast to Autografts, they help prevent postoperative donor site morbidity in patients who have already suffered trauma. Allograft ADM results in better outcomes, faster rehabilitation, lower rupture rates, less pain and less adhesions.

5. Conclusion

One certainty in the continuously evolving orthopaedic surgery is the importance of having allograft as an option for the treatment of variety musculo-skeletal lesions. We can conclude that our results of using bone allografts with due care and attention in upper limb are very satisfactory and promising.

Compliance with ethical standards

Acknowledgments

We thank Lifenet Health, Virginia Beach, Virginia, USA, for providing Decellularized Dermal Matrix (Dermacell), Bone Allografts. and DBM Putty (BLX Putty).

Disclosure of conflict of interest

The Authors declare that there is no actual or potential conflict of interest in relation to this case study.

Statement of informed consent

Informed consent was obtained from the participant included in the study.

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