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Original Article

NON-VASCULARIZED TOE PHALANX TRANSFER FOR RECONSTRUCTION AFTER FINGER DISTAL PHALANX OSTEOBLASTOMA IN A CHILD: CASE REPORT AND SURGICAL TECHNIQUE

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ABSTRACT

Osteoblastoma is a benign neoplastic lesion of the bone and it is rarely found in the wrist and hand, with only a few reported cases. Treatment typically involves curettage and marginal excision. We report a rare case of osteoblastoma located in the distal phalanx of the fourth finger in a 9-year-old boy. We treated it surgically with a non-vascularized free toe phalanx transfer, a well-known and acceptable technique commonly used to treat certain pediatric congenital hand deformities and our case showed that it can effectively treat finger distal phalanx osteoblastoma with good outcomes. The patient was followed for three years postoperatively without signs of local recurrence. We present this case to alert radiologists and surgeons regarding this rare tumor and to highlight the surgical technique of using a toe phalanx graft as a viable and feasible option for the treatment of hand phalangeal tumors.

الخلاصة

يُعد ورم بانيات العظم ورمًا عظميًا حميدًا نادر الحدوث في منطقة الرسغ واليد، مع وجود حالات قليلة فقط تم الإبلاغ عنها. عادةً ما يشمل العلاج الكحت والاستئصال الهامشي. نعرض في هذا التقرير حالة نادرة لورم بانيات العظم يقع في السلامية البعيدة من الاصبع الرابع لطفل يبلغ من العمر 9 سنوات. تم علاج الحالة جراحيًا باستخدام نقل حر غير وعائي لسلامية إصبع القدم، وهي تقنية معروفة ومقبولة تُستخدم عادةً لعلاج بعض التشوهات الخلقية لليد عند الأطفال وفي هذا التقرير نجد أن الطريقة المذكورة قد تقدم نتائج جيدة لعلاج ورم بانيات العظم في السلامية البعيدة من الاصبع. تمت متابعة المريض لمدة ثلاث سنوات بعد العملية دون وجود علامات على عودة الورم موضعيًا. نعرض هذا التقرير لتنبيه اطباء الأشعة والجراحين لهذا الورم النادر وتوضيح التقنية الجراحية المستخدمة كخيار متاح وسهل لعلاج الأورام الحميدة لسلاميات أصابع اليد.

Keywords: Bone Graft, Hand Neoplasm, Osteoblastoma, Phalanges, Toe Phalanx Transfer

1. INTRODUCTION

Osteoblastoma refers to a benign neoplastic lesion of the bone, accounting for 1% of all primary tumors of the bone (1). It can occur in individuals between the ages of six and 75 years; however, it is most commonly encountered in adolescents and individuals in early adulthood (2). The highest percentage of osteoblastoma lesions occurs in the spinal column (32–46%), followed by long bones and the mandible (3). Osteoblastoma is rarely found in the wrist and hand, although there is an increasing number of studies reporting such cases, particularly in the carpal bones. A review of the English literature revealed four cases of osteoblastoma in the metacarpals. For the phalanges, we found three cases in the proximal phalanx, one of them was in the thumb, and one case where the lesion was in the distal phalanx (4–11). Treatment of osteoblastoma is usually surgical and ranges from intralesional curettage to marginal or wide resection, depending on the subtype (benign vs. aggressive) and the location of the lesion (12).

The literature review was conducted using studies published in the English language and to our knowledge, this is the second report in the literature utilizing

the toe phalanx graft for tumor cases involving the phalanges. The aim of this paper is to alert radiologists and surgeons regarding this rare tumor and to highlight the surgical technique of using a toe phalanx graft as a viable and feasible option for the treatment of hand phalangeal tumors.

2. CASE REPORT

A nine-year old male with no significant medical history was presented to our institution with a one-year history of gradually increasing size and deformity, along with persistent pain, tenderness, and excessive sweating in the distal part of his left ring finger. The patient reported no history of trauma or infection. On examination, the left ring finger appeared enlarged beyond the proximal interphalangeal joint, with a mild clubbed nail deformity [Figure 1A, 1B]. The skin surrounding the nail plate appeared swollen, shiny, and discolored. The ring finger was warm on palpation. A slightly reduced range of motion was noted in the distal interphalangeal joint compared to the contralateral hand. Blood work, including tests for inflammation and rheumatic conditions, was within normal ranges, and the CRP test was negative. Radiographs indicated the presence of an expansile osteolytic lesion at the distal phalanx, with endosteal scalloping and cortical thinning [Figure 2A, 2B]. MRI done with and without contrast and showed soft tissue swelling with heterogenous high signal intensity on the STIR corresponds to mixed signals intensity on T2 with low signal intensity T1-weighted images. There was bony involvement manifested by abnormal low signal intensity of the distal phalanx in all sequences without contrast, and high intense heterogenous enhancement with contrast. The size of the lesion was 18x13mm. No collection was seen in MRI and the visualised muscles were unremarkable [Figure 3A, 3B]. Based on radiological and clinical findings, the lesion was considered a benign primary tumor.

Figure 1. (A.B) clinical photos showing the left ring finger appeared enlarged beyond the proximal interphalangeal joint, with a mild clubbed nail deformity. The skin surrounding the nail plate appeared swollen, shiny, and dis coloured.

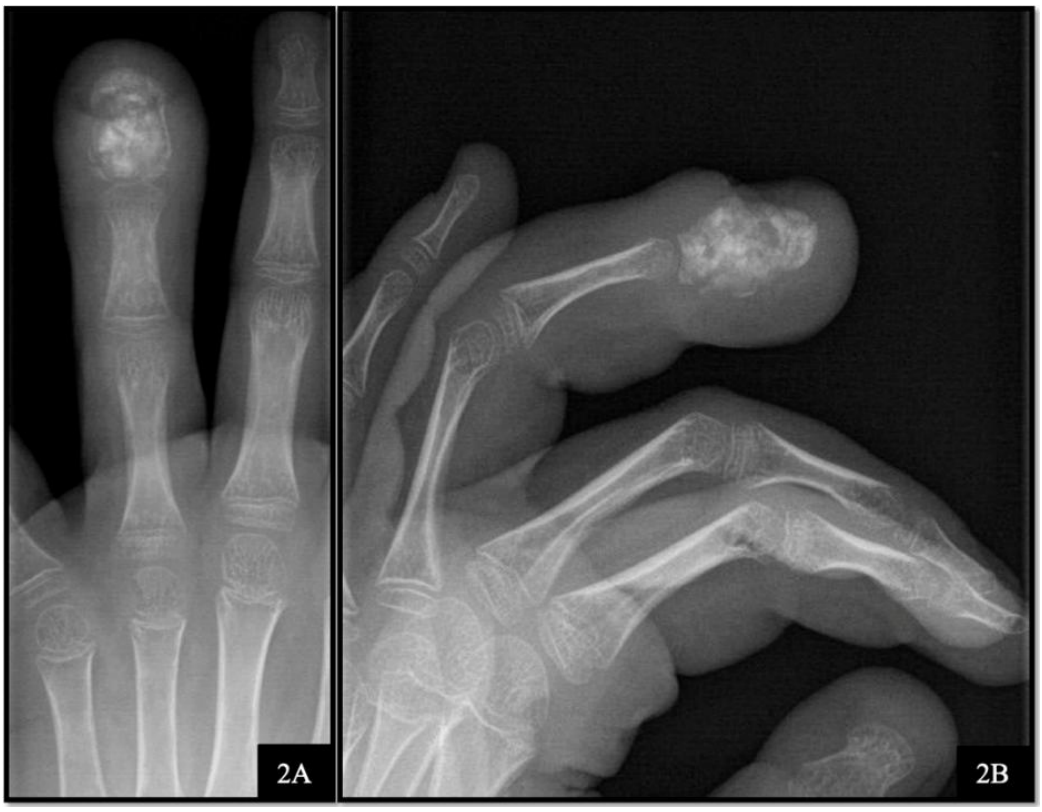

Figure 2. (A,B) Radiographs of the left hand in anteroposterior and lateral projections demonstrating an expansile osteolytic lesion at the distal phalanx, with endosteal scalloping and cortical thinning.

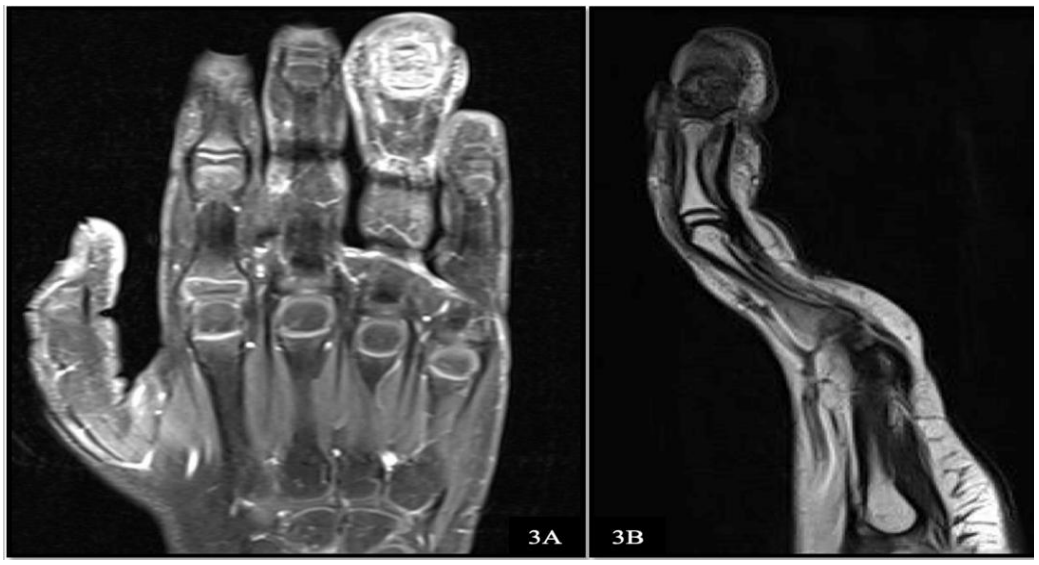

Figure 3. (A) T1-weighted post-contrast MRI in the coronal plane demonstrating hyperintense heterogenous enhancement of the distal phalanx of the fourth finger. (B) Non-contrast T2-weighted MRI in the sagittal plane showing low signal intensity of the distal phalanx.

3. SURGICAL TECHNIQUE

The surgery was performed in two stages in order to confirm the diagnosis before proceeding with the reconstruction. In the first stage, a trans-ungual approach was used on the dorsal side of the distal phalanx. A small curette was used for curettage. After the tumor was removed, a defect was formed, leaving only the cortical shield intact, no adjuvant treatment was used. A temporary Kirschner wire (K-wire) size 1.2 mm was used for stabilization [Figure 4A–4C]. The specimens were sent for histopathological analysis and for culture and sensitivity to rule out infectious process and the later came negative for bacteria and fungus. The histopathology report revealed multiple fragments of anastomosing thick bone trabeculae with osteoblastic rimming embedded in a loose fibrovascular stroma. Rare mitotic figures were identified. No atypical mitosis seen and no reactive bone surrounding the lesion was identified [Figure 5A, 5B]. The final diagnosis was confirmed by histopathology as osteoblastoma.

Ten days after the initial procedure, the patient underwent the second stage of surgery. In this stage, the phalangeal shaft graft was transferred from the ipsilateral fourth toe proximal phalanx to reconstruct the defect in the distal

phalanx of the fourth finger and the size of the graft was 12x5mm. A K-wire was passed retrograde from the tip of the finger to the middle phalanx base, transfixing the distal interphalangeal (DIP) joint. A cancellous allograft matching the size of the transferred shaft was inserted as a spacer to reduce donor site morbidity, and the K-wire was driven proximally [Figure 6A–6E]. The digit was immobilized with a below-elbow cast for four weeks. The K-wire was removed at four weeks where clinical healing was evident, and gradual use of the hand was encouraged. The foot was immobilized in plaster for six weeks, and the K-wire was removed at the six-week mark. The finger was monitored closely for three years. The patient remained pain-free and no infection or delayed union were encountered, although the DIP joint was stiff at 15 degrees of flexion [Figure 7A]. Sequential radiographs showed no evidence of local recurrence [Figure 7B, 7C]. There was no significant donor site morbidity as the range of motion of the fourth toe and the gait of the patient were not affected.

All procedures were performed by the same consultant who is a Pediatric Orthopedic and Hand surgeon.

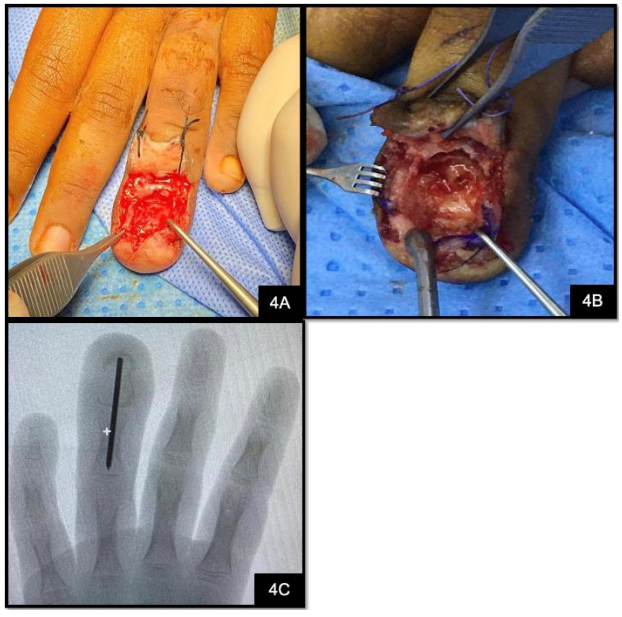

Figure 4. (A) Intra-operative photograph illustrating the dorsal approach of the distal phalanx. (B) Intra-operative photograph showing the distal phalanx after curettage leaving the cortical shield intact. (C) Intra-operative x-ray demonstrating the finger with temporary k-wire used for stabilization.

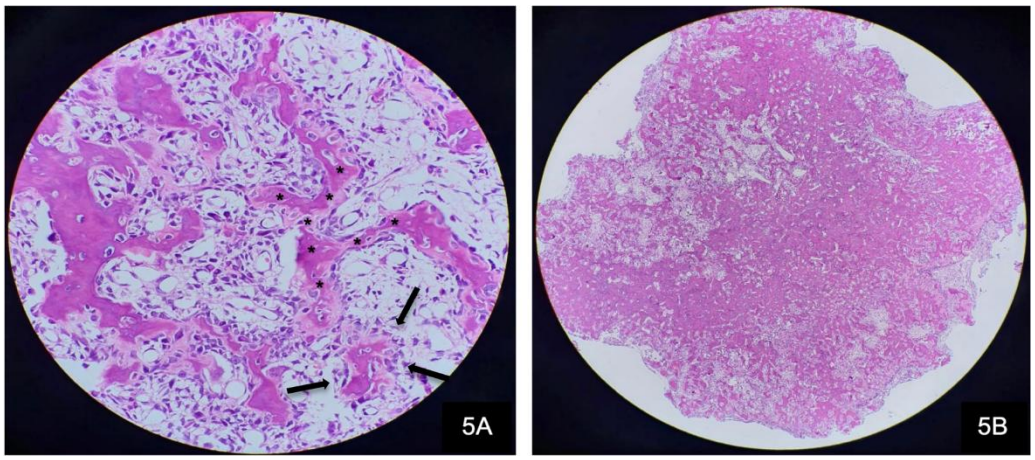

Figure 5. (A,B) High and low power fields histopathological images of the excised tumor showing irregular anastomosing thick bone trabeculae (asterisk) with osteoblastic rimming (arrows) embedded in a loose fibrovascular stroma.

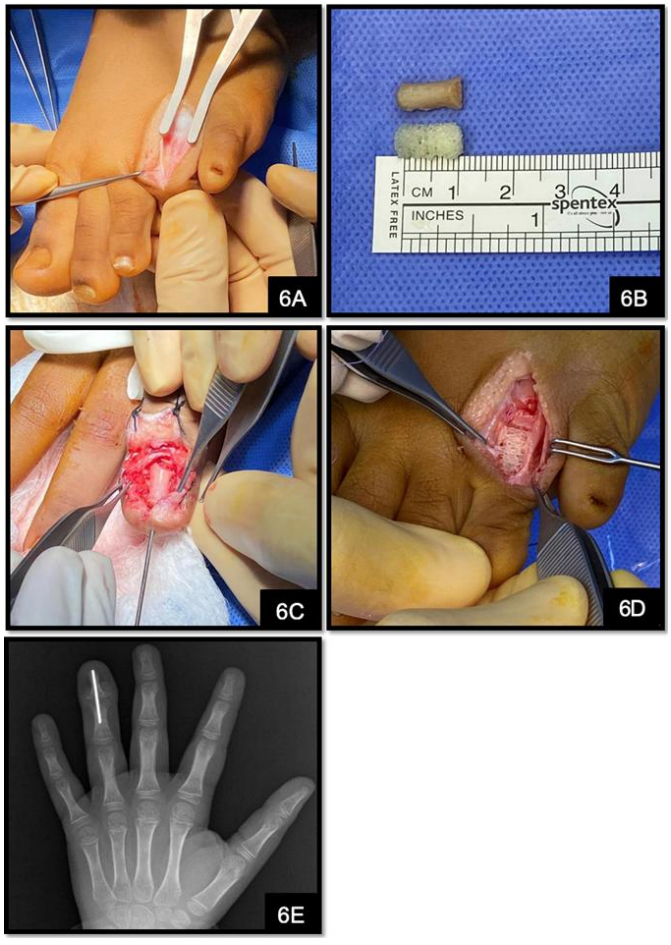

Figure 6. (A) Intra-operative photograph of the left foot with dorsal approach

to the proximal phalanx of the fourth toe from which the phalangeal shaft was transferred to reconstruct the defect in the distal phalanx of the fourth finger. (B) Intra-operative photograph showing the transferred phalangeal shaft (above) and a cancellous allograft (below). (C) Intra-operative photograph of the left fourth toe showing the cancellous allograft after it was inserted as a spacer to reduce donor site morbidity. (D) Intra-operative photograph of the left finger after the k-wire was passed in a retrograde manner from the tip of the finger to the base of the middle phalanx. (E) Intra-operative x-ray showing the transferred graft in place, fixed with a k-wire.

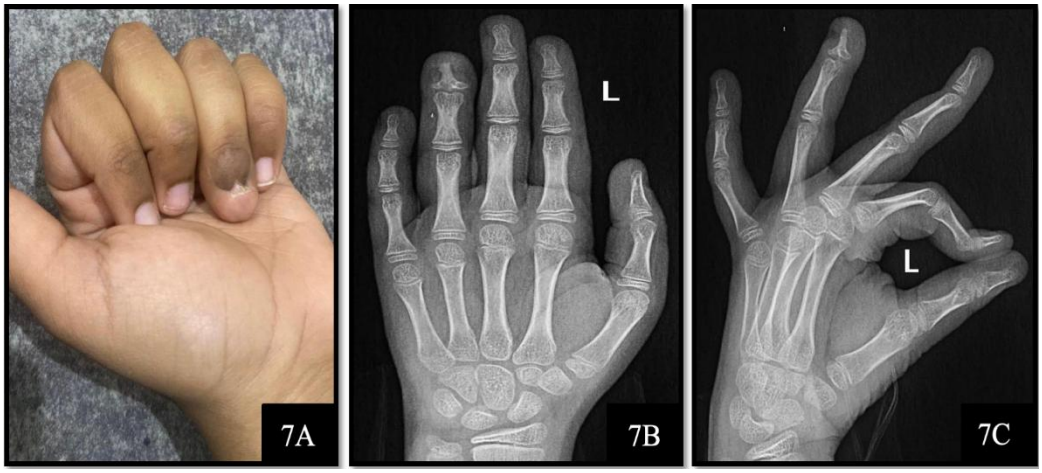

Figure 7. (A-C): (A) Clinical photograph of the patient's hand three years after the surgery. (B,C) AP and lateral radiograph of the left hand three years after surgery, showing no evidence of recurrence.

4. DISCUSSION

Managing benign hand tumors with curettage and bone grafting, with or without adjuvant treatment has been a common practice and literature review shows variable rates of recurrence (13, 14). In a retrospective study by Saglik Y. et al. involving 20 cases of osteoblastoma, recurrence was noted in patients treated with marginal excision or intralesional curettage, while no recurrence was observed after wide surgical resection. The overall recurrence rate was 10% (15). In a case report of first metacarpal osteoblastoma, Kooner et al. successfully treated the patient non-surgically with denosumab, which transformed the locally destructive tumor into an ossified, painless mass and restored function (7).

Two cases of proximal phalanx osteoblastoma were found in the literature: one was treated with en bloc surgical resection of the lesion and curettage, while the other was managed with marginal excision biopsy and curettage (8, 10). For distal phalanx osteoblastoma, Gumustas et al. successfully treated their case with curettage and polymethylmethacrylate filling, with no recurrence at two years of follow-up (9).

Non-vascularized free toe phalanx transfer has been used primarily for congenital hand deformities, where it provides length, stability, and movement (16). In a retrospective study by Kawabata H. and colleagues, 54 non-vascularized toe phalanx transfers were reviewed in 29 children with symbrachydactyly. The transferred toe phalanges grew at a near-normal rate in the first five years, with growth slowing between five and 10 years (17).

Using a non-vascularized free toe phalanx transfer for phalangeal tumors of the hand has been reported in only one other case, involving a 50-year-old woman with a giant cell tumor affecting the base of the proximal phalanx. No tumor recurrence was observed at the 24-month follow-up (18). For benign lesions of the metacarpals, a study reported the treatment of nine patients using matched metatarsal transfer (19). The use of a non-vascularized bone graft offers simplicity and a lower cost compared to a vascularized bone graft and the ability to be performed in a low resource setting where microsurgery is not feasible.

5. CONCLUSION

In summary, osteoblastoma of the phalanges is rare, but growing reports of hand lesions are making it less uncommon. Non-vascularized toe phalanx transfer can effectively treat finger distal phalanx osteoblastoma with good outcomes. We present this case to alert radiologists and surgeons regarding this rare tumor and to encourage sharing any modifications that could further improve long term results.

6. CONSENT AND ETHICAL CONSIDERATION

Written informed consent was obtained from the patient’s guardian for publication of this case report and the accompanying images.

7. CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

8. FUNDING

This research received no external funding.

9. DECLARATION OF GENERATIVE AI

During the preparation of this work the authors used GPT-4.1 (OpenAI, San Francisco, USA) to improve the readability of some of the sections, assure homogeneity of the passages and reduce redundancies in writing. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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