奈医誌. (J. Nara Med. Ass.) **43,** 162～166, 1992

UNEXPECTED ECTOPIC BONE FORMATION ON THE DORSUM OF A FOOT AFTER FREE PERONEAL FLAP TRANSFER : A CASE REPORT

HIROSHI YAJIMA, SUSUMU TAMAI,
SHIGERU MIZUMOTO, KOICHI KAWANISHI and HITOSHI ISHIDA
Department of Orthopaedic Surgery, Nara Medical University

Received March 28, 1992

Summary : We experienced a case in which ectopic bone formation with trabecular structures occurred after free peroneal flap transfer containing periosteum of a fibula onto a soft tissue defect on the dorsum of a foot in a 2-year 9-month-old boy. In this case, ectopic bone formation was detected by radiography 5 months after the operation and the bone was removed because of the restricted dorsiflexion of the ankle. This case suggests that new bone can be formed by the periosteum if it is grafted with its vasculature preserved by microvascular anastomosis.

Index Terms

peroneal flap, vascularized periosteal graft, periosteum, new bone formation

INTRODUCTION

The osteogenic capacity of periosteum has been recognized by numerous investigators, but is the subject of coutinuing controversy. Discrepant results in different studies have been attributed chiefly to differences in the viability of grafted periosteum. Bearing this in mind, Finley et al.[1] in 1978 conducted an experimental study on vascularized periosteal grafts and observed excellent bone formation. This technique was clinically applied by Satoh et al.[2] in 1983 to treat a comminuted fracture of the tibia. They performed vascularized iliac musculo-periosteal free flap transfer, with excellent bone union obtained. However, it has not yet been documented whether or not the new bone originated from the grafted periosteum.

We experienced an interesting case in which ectopic bone formation with trabecular structures occurred after a free peroneal flap transfer onto a soft tissue defect on the dorsum of a foot in a child.

CASE REPORT

A 2-year 9-month-old boy was hit by a car on April 4, 1988, and suffered a crush wound to his right foot. He was transported to an emergency hospital. After débridement, the wound was covered with artificial skin (PVFA ; polyvinyl formaldehyde sponge), and the boy was referred to our hospital. Upon arrival at our hospital, the lateral aspect of the ankle to the dorsum of the right foot was covered with PVFA. Radiographs showed a greenstick fracture in the lower 1/4 of the fibular diaphysis. He underwent a soft tissue reconstruction using a free peroneal flap transfer on May 9. When the PVFA was removed from the right foot, the

fibular epiphysis, a part of the cuboid bone and the head of the fifth metatarsal bone were denuded, and the peroneus brevis tendon and extensor digitorum communis tendon were found to be partially defective (Fig. 1). After débridement, we elevated a peroneal flap (10×7 cm) designed at the center of the ipsilatemal leg. Dissection was carried out according to the method of Yoshimura et al.[3] While confirming the presence of the fasciocutaneous perforating branch, the vessels were dissected deeply towards the peroneal artery and vein. After arrival at the peroneal artery and vein, the vessels were further dissected towards the proximal region. Because many periosteal branches derived from the peroneal artery and vein, a part of the periosteum attached to the peroneal artery and vein was detached from the fibula. Thus, of necccesity, the flap was transferred as a periosteal-cutaneous flap. Under an operative microscope, the peroneal artery was anastomosed to the dorsalis pedis artery and venae commitantes were anastomosed to the venae commitant of the dorsalis pedis artery and the saphenous vein. The flap was grafted without any trouble (Fig. 2), and the postoperative course was uneventful. Radiographs taken 5 months postoperatively revealed ectopic bone formation (5×0.8 cm) beneath the grafted skin flap, suggesting a bone formation from the fibular periosteum which had been attached to the vascular bundle of the peroneal flap (Fig. 3).

During the follow-up period, the patient's mother drew our attention to the child's frequent

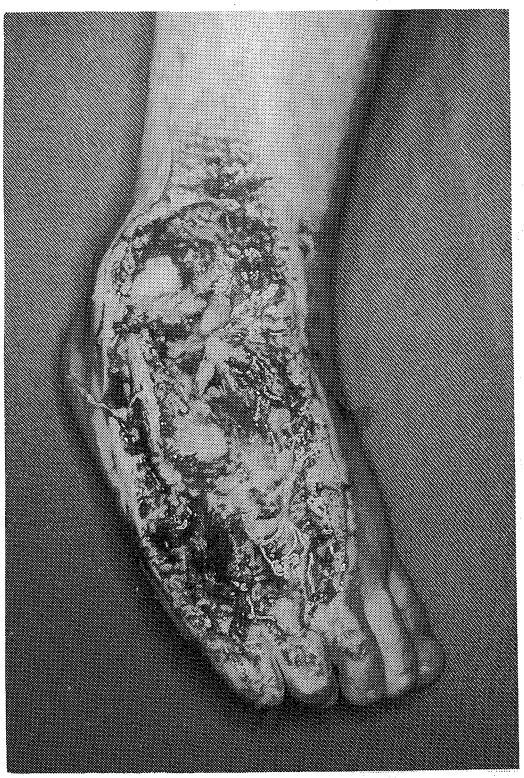

Fig. 1. Pre-operative photograph of the right foot showing the denuded fibular epiphysis, a part of cuboid bone and the head of the fifth metatarsal bone.

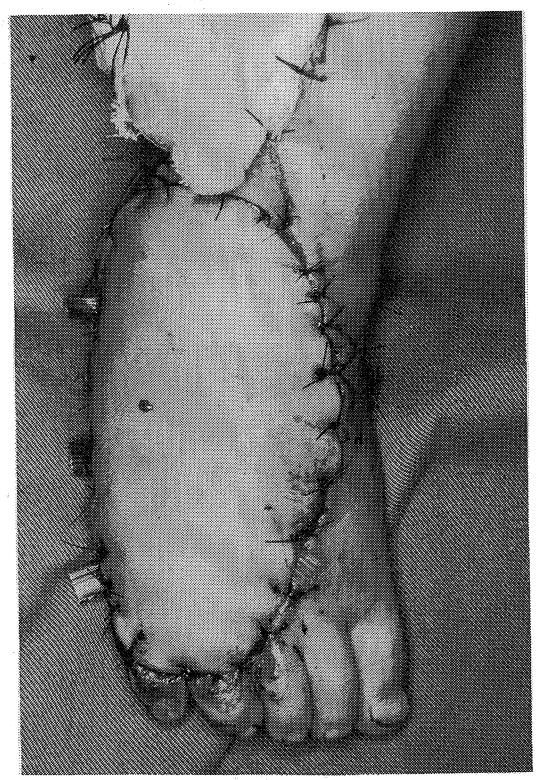

Fig. 2. Peroneal flap (10 × 7 cm) was transferred to cover the defect on the dorsum of the right foot.

falls due to restricted dorsiflexion of the ankle. The child therefore underwent on March 27, 1989, the removal of the ectopic bone (formed beside the peroneal artery and vein), defatting of the flap and web plasty of the third interdigital space (Fig. 4). Softex radiography of the excised bone revealed evident trabecular structures. Histologically, lamellar bone with

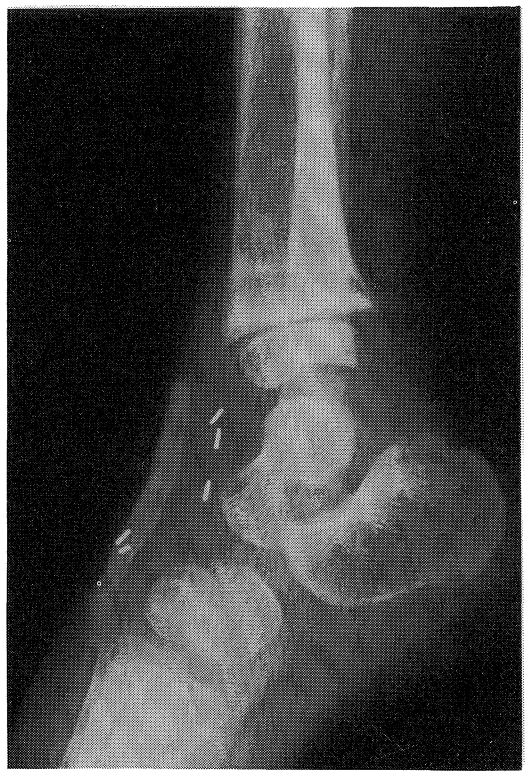

Fig. 3. Radiograph showing an ectopic bone formation.

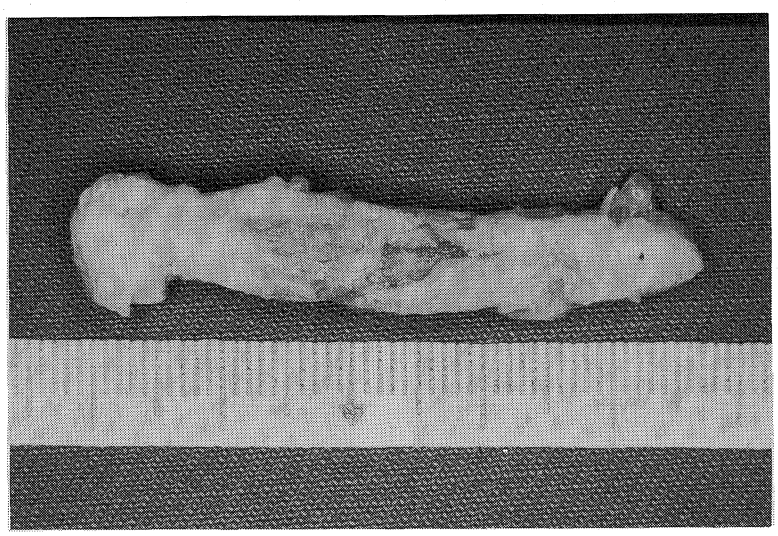

Fig. 4. The excised ectopic bone.

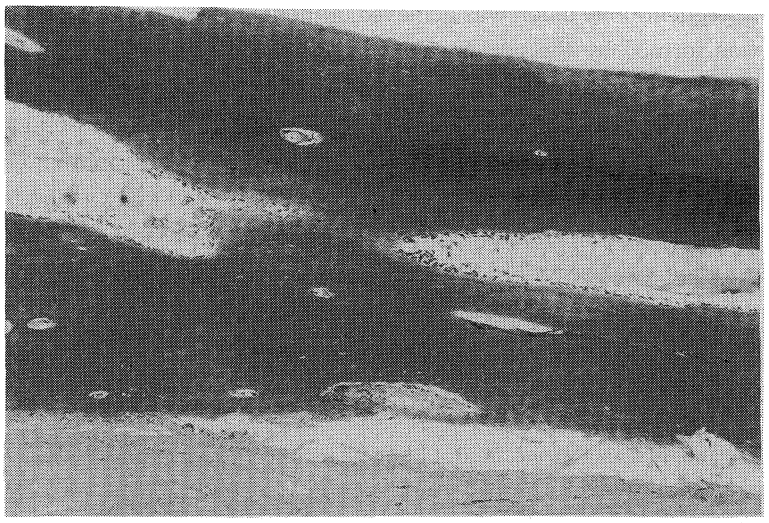

Fig. 5. Photomicrograph showing lamellar bone with trabecular structures (×40).

trabecular structures was observed with numerous osteoblasts present around the bone on the trabecular walls (Fig. 5).

At present, 2 years after the ectopic bone removal, no further bone formation is visible on the foot, and the condition of the flap is good. Radiographically, the epiphyseal line appears normal, with no growth abnomalities such as leg length discrepancy or ankle deformity.

DISCUSSION

The first experimental study on the osteogenic capacity of periosteum was conducted by Duhamel in 1739. In this study, bone formation was observed after insertion of a silver ring beneath the periosteum. Subsequently, many experimental studies on free periosteal grafts have been performed, although the results obtained have been inconsistent (that is, the osteogenic capacity of the periosteum was affirmed by some studies and denied by others). Skoog[4] and Ristasila[5] reported the use of periosteum clinically for repair of an alveolar cleft. However, this method has not been widely accepted. At present, a majority of investigators dispute the osteogenic capacity of free periosteal grafts, and many orthopedic surgeons, including the present authors, generally perform free bone grafting after removal of periosteum. However, as supported by various experimental evidence, it is certain that periosteum possesses an osteogenic capacity in its cambium or deeper layer.

The failure to achieve bone formation in free periosteal grafts by some in the past has been attributed to the environment of the recipient bed in cases in which a non-vascularized periosteum was grafted. Based on this assumption, vascularized periosteal grafting has been experimentally studied. Excellent bone formation after vascularized periosteum grafting was reported by Finley et al.[1] using dogs, by Puckett et al.[6] using goats, and by Takato et al.[7] using rabbits. Clinically, Satoh et al.[2] created vascularized iliac musculo-periosteal flap, and Sakai et al.[8] grafted periosteum of the medial condyle of the femur with a thin cortical bone attached.

In both studies, excellent bone union was achieved, although it was not clarified whether or not the new bone was formed by the periosteum per se. In our case, peroneal periosteum was attached to the vascular bundle of the flap to facilitate easy detachment of the peroneal artery and vein from the fibula during the peroneal flap elevation. Although periosteal grafting in this case was not our final goal, it resulted in unexpected ectopic bone formation with trabecular structures. This finding is clinically very interesting. It is well-known that the fibula can regenerate after its resection in children, if its periosteum has been left intact. In the literature, ectopic bone formation, as observed in the pesent case, has not been reported. Our finding lend support to the contention that new bone can be formed by the periosteum if it is grafted with its vasculature preserved by microvascular anastomosis.

REFERENCES

1) **Finley, J. M., Acland, R. D.** and **Wood, M. B.** : Revascularized periosteal grafts : A new method to produce functional new bone without bone grafting. Plast. Reconstr. Surg. **61** : 1-6, 1978.

2) **Satoh, T., Tsuchiya, M.** and **Harii, K.** : A vascularized iliac musculo-periosteal free flap transfer : A case report. Br. J. Plast. Surg. **36** : 109-112, 1983.

3) **Yoshimura, M., Imura, S., Shimamura, K., Yamauchi, S.** and **Nomura, S.** : Peroneal flap transfer for reconstruction in the extrerity : Preliminary report. Plast. Reconstr. Surg. **74** : 402-409, 1984.

4) **Skoog, T.** : The use of periosteum and surgical for bone restoration in congenital clefts of the maxilla : A clinical report and experimental investigation. Scand. J. Plast. Reconstr. Surg. **1** : 113-130, 1967.

5) **Ritsila, V., Alhopuro, S.** and **Gylling, U.** : The use of free periosteum for bone formation in congenital clefts of the maxilla : A preliminary report. Scand. J. Plast. Reconstr. Surg. **6** : 57-60, 1972.

6) **Puckett, C. L., Hurvitz, J. S., Metzler, M. H.** and **Silver, D.** : Bone formation by revascularized periosteal and bone grafts, compared with traditional bone grafts. Plast. Reconstr. Surg. **64** : 361-365, 1979.

7) **Takato, T., Harii, K., Nakatsuka, T., Ueda, K.** and **Ootake, T.** : Vascularized periosteal grafts : An experimental study using two different forms of tibial periosteum in rabbits. Plast. Reconstr. Surg. **78** : 489-497, 1986.

8) **Sakai, K., Doi, K., Tamaru, K., Yamamoto, M.** and **Kawai, S.** : Free vascularized bone and periosteal graft for pseudoarthrosis in the upper limb. J. Jpn. Soc. Surg. Hand **5** : 698-704, 1988. (in Japanese)