Case Report

Role of ^{99m}Tc-methylene diphosphonate bone scan in the evaluation of the viability of the bone flap in mandibular reconstruction in patients with oromaxillofacial malignancies

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ABSTRACT

Osteo-cutaneous flap are commonly used for reconstruction of bone defect after oncology surgery. The success of surgery depends on the viability of the bone flap. Bone scan is a known, but less performed method, to look for viability of bone flaps. We describe a case of 50-year-old lady, presenting with squamous cell carcinoma of left buccal mucosa (cT4N1M0) involving the skin and mandible. She underwent left segmental mandibulectomy and upper alveolectomy with neck dissection, followed by reconstruction using a fibular osteo-cutaneous flap and anterolateral thigh free flap. On postoperative day 10, the intraoral flap showed signs of nonviability. The patient was sent to nuclear medicine for assessment of viability of the free fibula flap. The patient underwent three phase ^{99m}Tc-methylene diphosphonate (MDP) bone scan and single-photon emission computerized tomography. Computerized tomography showing good tracer uptake in fibula confirming viability. The case reflects the use of ^{99m}Tc-MDP in viability assessment of the bone flap.

Keywords: ^{99m}Tc-methylene diphosphonate, bone scan, fibular graft, osteo-cutaneous flap, viability

INTRODUCTION

Oromaxillofacial malignancies are commonly encountered in India due to rampant use of tobacco. Wide local excision of the tumor with underlying involved bone (usually mandible or maxilla) and appropriate reconstruction and adjuvant radiotherapy is the norm of the day. For the reconstruction of bony defects, the rib, iliac crest, scapula, and fibula, have been used as vascularized bone grafts by free tissue transfer, whereas sternum and clavicle have been used as pedicled flaps.[1,2] The free fibula flap was first used by Hidalgo *et al*.[3] for mandibular reconstruction owing to its large caliber pedicle vessels for microsurgical anastomosis, long pedicle length, and strong cortical bone.

The success of reconstruction depends on good blood supply to the bone flap. Vascular occlusion may result in flap necrosis and failure. Nuclear medicine imaging using ^{99m}Tc methylene diphosphonate (MDP) can be used in detecting nonviability and is also helpful in postoperative follow-up of bone flaps used for mandibular reconstruction.[4] The vascular supply can also be assessed by angiography, duplex sonography, and radiography. We present a case report, which highlights the importance of ^{99m}Tc MDP imaging in the assessment of the bone flap viability.

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CASE REPORT

A 50-year-old female, presented to our hospital with left cheek swelling. She had an ulcerative lesion in the left buccal mucosa infiltrating the mandible and skin with enlarged left level 1b nodes, which was confirmed by a computerized tomography (CT) scan. Biopsy confirmed it to be squamous cell carcinoma of the left buccal mucosa (cT4N1M0). She underwent wide local excision with segmental mandibulectomy, upper alveolectomy and selective neck dissection (level I–V) [Figure 1]. The oral mucosa and bone defect was reconstructed using a free fibula osteo-cutaneous flap. The fibula was osteotomized at three places to give the shape of the mandible and fixed with the help of reconstruction plate and screws. The cheek skin was reconstructed using free anterolateral thigh flap.

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On postoperative day (P.O.D) 10, the intraoral skin flap showed signs of necrosis. The concern was viability of underlying bone and was referred to nuclear medicine to assess the viability of the same. She underwent three phase ^{99m}Tc -MDP bone scan followed by single-photon emission computerized tomography (SPECT). CT of the concerned region. Flow and immediate images showed radiotracer flow and pool in the left cheek confirming good blood supply to the fibular flap. Delayed planar imaging and SPECT-CT done after 2 hour showed good tracer uptake in the fibula suggesting that the bone flap was viable [Figure 2]. The

Figure 1: (a) Preoperative image of buccal carcinoma infiltrating the skin and mandible. (b) Intra-operative image after hemimandibulectomy. (c) Fibular graft harvested from the patient. (d) Intra-operative image showing the graft with plate and screws *in situ*. (e) Necrosis of intraoral graft on postoperative day 10

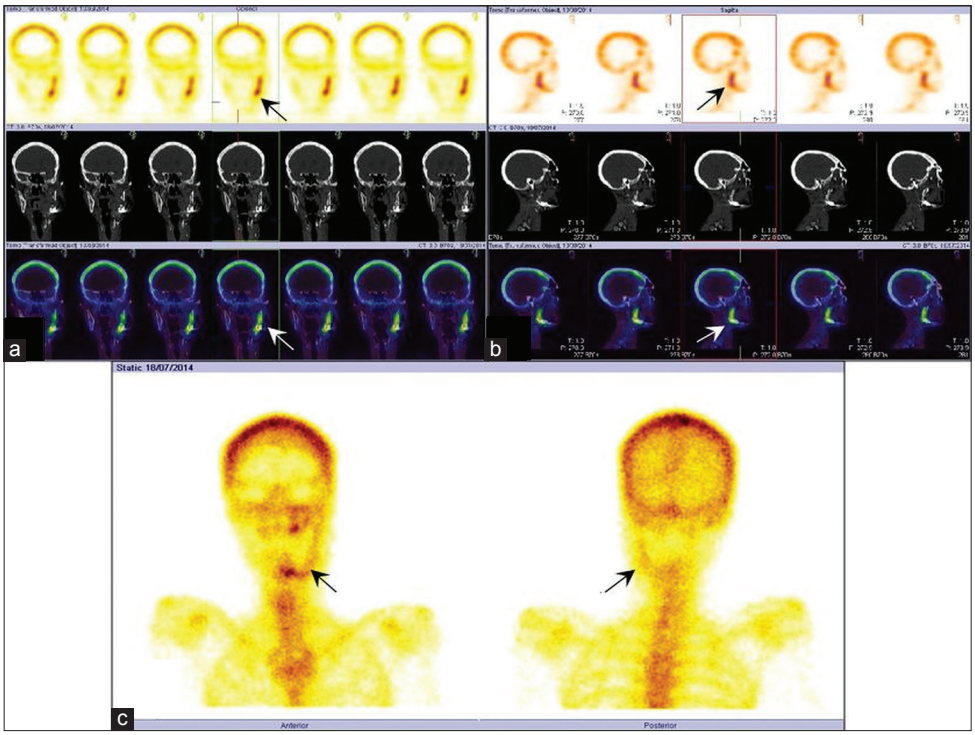

Figure 2: (a) Coronal and, (b) Saggital SPECT-CT images of skull showing good tracer uptake in the fibular graft with plate *in situ*. (c) Planar image showing good tracer uptake in the graft on left side suggestive of viability of the graft

skin paddle was excised, and a lateral tongue flap was used to resurface the reconstructed mandible.

DISCUSSION

Bone scan using ^{99m}Tc MDP is an important tool in the assessment of the bone flap viability. It is a simple, noninvasive method, but still not routinely performed in the hospitals. ^{99m}Tc MDP uptake in bone flap reflects the blood flow and metabolic activity of the flap, which is an indirect evidence of bone survival. Bos *et al*.[5] raised the possibility of false positive bone imaging due to "creeping substitution" where new bone forms on the surface of the flap. However, other authors who performed sequential bone scans did not find any false positive in their study.[4,6]

Flap viability can also be assessed by radiographs, duplex sonography and angiography. However, radiographs require 30–40% alteration in bone mineral metabolism to be positive.[7] Similarly angiography is an invasive procedure that cannot show microcirculation which determines viability, while sonography is highly operator–dependent, requiring great skill to get useful information. The first 2 weeks are critical for the viability of the flap.[8] If the intraoral skin necroses, as it happened in our case, it is difficult to assess whether the underlying bone flap is viable or not. The skin paddle can show necrosis without the loss of viability of the underlying bone.[9] It becomes imperative in this context to assess the viability of underlying bone. Kirschner *et al*.[10] compared duplex sonography, angiography and 3 phase bone scan using ^{99m}Tc-MDP to assess microvascularity and viability of femur transplants in three patients and compared it with intra-operative biopsies. They concluded that bone scintigraphy, as a single noninvasive investigation, provides useful information regarding viability and perfusion of the transplant.

Berding *et al*.[7] introduced a visual six grade scoring system based on a comparison of tracer uptake in the bone flap and calvarial uptake. Buyukdereli *et al*.[11] evaluated 16 patients using the same grading system and found that uptake in flap more than or equal to calvarium, that is, grade I–IV had an uneventful further course while those having decreased uptake (grade V) or no uptake (grade VI) presented with complications later-on. Lauer *et al*.[12] in their study on 36 patients showed that transplant to cranium (T/C) ratio of more than one had uncomplicated healing compared with those showing T/C ratio of less than one especially in immediate postoperative period. Harada *et al*.,[4] in their study, performed sequential bone scan in ten patients till 1-year and found it very helpful in assessing the viability and anastomotic patency of the bone flap.

Bone SPECT imaging increases the diagnostic accuracy for detection of viability of bone flap owing to better signal to noise ratio by removing superimposed activity, especially in immediate postoperative period and when overlying skin is necrosed leading to surrounding soft tissue hyperemia.[10-12] In the present case study, we performed SPECT imaging of the bone flap which showed good tracer uptake in the flap confirming the viability of the flap.

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