Closure of an Oronasal Fistula in an Irradiated Palate by Tissue and Bone Distraction Osteogenesis

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Uses for distraction osteogenesis in the craniofacial skeleton have expanded during the last decade. It has become an important rung in the reconstructive ladder for correction of difficult defects. Distraction of irradiated bone has been successfully performed in an animal model but has not been reported in human subjects. We present a case of distraction osteogenesis in a patient with multiple failed reconstructive attempts to close an irradiated palatal defect. An additional benefit included improvement in support of the upper lip from bone transported and the potential for placing dental implants.

Key Words: Oronasal fistula, palate, irradiation, distraction osteogenesis

Applications of distraction osteogenesis (DOG) in the craniofacial skeleton have grown in the last decade.1 DOG has been used 1) to lengthen the mandible in patients with craniofacial microsoma and micrognathia, 2) to advance the maxilla after Le Fort I osteotomy, 3) to advance the midface and/or forehead after Le Fort III or monobloc osteotomy, and 4) to expand the orbits.2–5 The principles of DOG have also been used to correct mandibular defects after ablative surgery or trauma with bone transport.6

DOG has been attempted to lengthen the hard palate for velopharyngeal incompetence and has been successfully performed in the canine palate.7–9 It has not been clinically used in irradiated bone, perhaps because of poor vascularity and poor wound healing. However, DOG of an irradiated canine mandible showed stable bone healing after a consolidation phase.10

In this article, we present a patient with a large oronasal fistula after maxillary tumor resection and irradiation. Failure of several procedures using local mucosal turn-in flaps and pedicled temporalis myosseous flaps led to a persistent oronasal fistula. When the patient refused to undergo a radial forearm microvascular free flap, we offered DOG of the anterior segment of the remaining palate to close the defect. The purpose of this article is to show that DOG is a viable method of oronasal fistula closure and reconstruction of difficult defects in an irradiated palate.

CASE REPORT

A 53-year-old man was seen with a large oronasal fistula in an irradiated palate after multiple failed attempts at closure. He had previously undergone an anterior maxillary resection and postoperative radiation (4,500 rad) for a squamous cell cancer 5 years before. Immediate reconstruction consisted of only soft-tissue closure and resulted in deficiency of the alveolar ridge, bony hard palate, and caudal bony septum of the nose. Subsequently, he developed a large oronasal fistula that also included the right maxillary sinus. Attempted closures of the fistula with local mucosal flaps and an iliac bone graft failed. A temporalis myofascial osseous turnover flap containing a “L”-shaped calvarial bone (outer table) was then tunneled to reach the intraoral defect. Postoperatively, this resulted in soft-tissue sloughing, extrusion of bone, complete resorption of the bone, and a recurrent large fistula. The patient was
then offered a radial forearm free flap to close the defect.

When we initially examined the patient, he had an appearance of midfacial collapse because of the absence of the anterior alveolar ridge and a relatively prominent lower lip (Fig 1). Intraorally, two right molars remained. A 1.5 × 2.0-cm oronasal fistula existed where the left canine and premolars would normally have been (Fig 2). The patient’s computed tomography scan confirmed the lack of left maxillary bone and anterior half of the palate.

DOG was undertaken to transport the remaining palatal bone to the left and toward the anterior defect (Fig 3). The procedure was begun with two incisions: one just anterior to the remaining right molars and the other at the posterior aspect of the oronasal fistula. A tunnel was created between these incisions to accommodate a reciprocating saw that was used for the osteotomy. The vomer was detached from this segment to mobilize it, but the palatal mucosa was left intact to optimize blood supply. Next, the piriform rim was exposed to allow for a nasal septal osteotomy and mobilization of the premaxilla. A distraction device (Howmedica-Leibinger Inc., Dallas, TX) was then fixed with 14-mm screws to the mobilized anterior palatal segment and to the remaining palatal bone posteriorly.

Postoperatively, after 48 hours, the patient began 1 mm per day distraction for 14 days. The palatal defect was obliterated in 9 days (Fig 4). Additional distraction added bone to the alveolar ridge and thus provided maxillary projection and improved lip support. The distraction device was removed after 4

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Fig 1. Photograph of the patient with a large oronasal fistula in an irradiated palate after multiple failed attempts at closure. Note the appearance of midface hypoplasia and the prominent lower lip from the loss of bone and soft tissue in the anterior maxilla.

Fig 2. Intraoral photograph of the patient demonstrating a large oronasal fistula in the anterior portion of his irradiated palate.
months. At the time of this procedure, mucosal flaps were elevated in the site of the fistula to definitively separate the oral and nasal mucosa and obliterate the communication. Posttreatment radiographs revealed new bone formation. The patient is being considered for anterior alveolar implants.

DISCUSSION

The technique of osseous distraction was first reported at the turn of the century when lengthening of the long bones of the lower extremity was described by Codivilla.11 These initial attempts, however, had an unacceptable rate of complication, including infection at the pin sites and skin necrosis beneath the distraction device. These problems were addressed by Ilizarov who contributed tremendously to better understanding of the principles of DOG. He showed that corticotomy alone with preservation of the periosteum and intramedullary elements yielded significantly improved results.12

Early distraction in the craniofacial skeleton was reported by Snyder et al. who, in 1973, showed that mandibular length could be successfully increased in a canine model using an extraoral device.13 A model of severe crossbite was created by removing a 1.5-cm segment of mandible and allowing the bone to heal with collapse of the ipsilateral mandible. A complete osteotomy was then performed, and the mandible was successfully distracted during a period of 14 days.

McCarthy et al. opened a new era by documenting the successful distraction of the human mandible in four subjects using a similar device.2 They showed that the membranous bones of the craniofacial skeleton were much more suited to surgical distraction than Illizarov’s endochondral bones of extremities. This was attributed to the smaller size, better blood supply, and ease of surgical manipulation. Their laboratory also elucidated the process of repair in the distracted bone. A longitudinal scaffold of collagen was produced and subsequent ossification pro-
ceeded from the free edges of the mandible. Also, four zones of membranous reossification in the human mandible could be recognized: 1) a fibrous, central zone, 2) a transition zone, 3) a remodeling zone, and 4) a peripheral, mature bone zone.

Carls et al. introduced DOG of the palate in a canine cleft palate model. DOG was used to lengthen the palate 7 to 10 mm caudally with intraoral devices attached to the dentition anteriorly and palate posteriorly. Ascherman et al. performed palatal distraction on five dogs fitted with a central, submucosal jackscrew apparatus and two anterior and two posterior footplates. They believe that distraction of the hard palate might be a viable option in

Fig 4. Intraoral photograph of the patient after distraction osteogenesis (DOG) was complete. (A) Distraction device shown after 14 mm of palatal lengthening. Although the fistula appeared closed at 9 days, additional DOG added bone to the alveolar ridge region for improved maxillary projection. (B) The oronasal fistula has been obliterated.
treating patients with velopharyngeal incompetence. Also, Molina and Jacobo have reported a small series of patients with improvements in velopharyngeal incompetence after palatal distraction.8

Although healthy bone has been shown to be successfully manipulated by distraction, this process has not been recommended to reconstruct defects of the head and neck after ablative radiation therapy. However, there have been attempted cases (J. G. McCarthy and S. U. Stucki-McCormick, personal communication, April 2000). Irradiated tissues have been shown to be relatively hypovascular and hypoxic compared with nonirradiated tissues.15 Various techniques have been used by those in the field of radiation oncology to minimize the effects of harmful radiation. One of these is fractionation, in which the total desired dose is split, or fractionated, over a fixed number of sessions. Gantous et al. showed that distraction of the craniofacial skeleton followed by stable healing is possible in an irradiated canine mandible.10 They subjected five dogs to a full course of radiation therapy designed to treat human squamous cell cancer of the oral cavity. Each animal received 50 Gy of radiation in 20 fractions during a period of 4 weeks. After 6 months, 20 mm of mandibular bone was removed and a transport fragment of mandibular bone was distracted anteriorly from the proximal mandibular segment. Four of the five animals demonstrated complete bony regeneration of the mandible. Bone within the distraction site was of comparable size and histologically similar to that of the remaining bone.

In the patient that we presented, the palatal defect resisted several attempts at closure. To bring in vascularized tissue into an irradiated area, he was offered a radial forearm flap. However, we thought that DOG was a simpler method to close the fistula and rebuild the anterior alveolus. Benefits of DOG include bringing vascularized soft tissue and bone to the defect without the distal donor site morbidity.

In summary, we presented a patient in whom palatal distraction was successfully used to close an oronasal fistula in an irradiated palate. The case highlights the importance of distraction osteogenesis as a therapeutic option in 1) less common areas of the craniofacial skeleton and 2) tissues damaged by the effects of radiation.

REFERENCES