Objective: To discuss the use of condylar prostheses after mandibular resection for tumor.

Design: Case series and literature review.

Setting: Tertiary referral center.

Patients: Four patients underwent condylar reconstruction with metallic condylar prostheses after hemimandibulectomy for either squamous cell cancer or Ewing sarcoma.

Main Outcome Measure: Complications related to the condylar prostheses.

Results: Clinical and radiological follow-up in these patients revealed several complications, including exposure or extrusion of the prosthesis and migration of the prosthesis into the epitympanum, resulting in profound sensorineural hearing loss owing to bony destruction of the cochlea. Two of our patients required removal of the mandibular hardware because of the seriousness of the complications, and 1 of the 2 underwent reconstruction of the condyle with a fibular free flap.

Conclusions: Metallic condylar prostheses in the setting of tumor resection and reconstruction involve significant risks. Autogenous materials, such as vascularized bone grafts, should be used whenever possible.


Condylar replacements have been used for many years in cases of ankylosis, severe degenerative diseases, tumors involving the condyle, osteomyelitis, dysplasia, congenital malformation, and trauma. Reconstruction of the condyle is performed to restore the joint as closely as possible to its normal position and function.

Use of alloplastic materials to replace the condyle was first reported by Gordon in 1955. Gordon’s rationale for using an alloplastic implant was to maintain functional mandibular ramus height, to avoid malocclusion, and to prevent mandibular hypomobility. The general opinion during the following years was consistent with Gordon’s concept that condylectomy without replacement would result in facial deformity, pain, and limitation of movement. A variety of alloplastic and autogenous materials were therefore advocated to replace the condyle. These included silicone rubber (Silastic), Proplast, and polytet (Teflon). Use of various metallic implants has also been reported, including the Christensen implant and the titanium-coated hollow-screw reconstruction plate, or THORP, system. Autogenous materials used for condylar replacement have included temporalis muscle/fascia flaps, osteochondral rib grafts, and vascularized bone grafts. Some of these materials have worked very well, especially in treatment of temporomandibular joint (TMJ) disorders, but others have caused devastating problems for patients. Reconstruction of the condyle after an ablative procedure for cancer remains a surgical challenge.

The purpose of this article is to describe our experiences with metallic condylar prostheses for reconstruction after tumor resection.

Report of Cases

During the period of September 1989 to April 1995, metallic condylar prostheses were placed in 4 male patients (mean age, 49 years). Three of the 4 patients underwent condylectomy and composite resection for retromolar trigone squamous cell
carcinoma. These patients also underwent a neck dissection and pectoralis major myocutaneous flap to reconstruct the soft tissues in the oral cavity/oropharynx. Also, they received preoperative (n=1) or postoperative radiotherapy (n=2). The other patient underwent a hemi-mandibulectomy, including resection of the condyle, for Ewing sarcoma. All 4 patients underwent immediate condylar reconstruction with either a 2.7-mm hemimandibular reconstruction plate (SYNTHERES; AO/ASIF Foundation, Paoli, Pa) (n=1) or a titanium reconstruction bar with condylar attachment (Stryker Leibinger, Freiburg, Germany) (n=3) (Figures 1, 2, and 3). Postoperatively and during follow-up, attention was given to any complications resulting from surgery. The mean follow-up time was 23.3 months.

Our patients were diagnosed as having several complications from 5 to 37 months after surgery, including cross-bite deformity and malocclusion (n=1), infection (n=2), and transient facial nerve paresis secondary to a dislodged prosthesis (n=1). One patient experienced migration of the prosthesis into the epitympanum, resulting in otorrhea and profound sensorineural hearing loss due to bony destruction of the cochlea (n=1) (Figure 4). During removal of his prosthesis, histopathologic evaluation of a middle ear mass revealed a granuloma reaction. The 3 patients who received radiation therapy had exposure or extrusion of the prosthesis (Figure 5). Despite conservative management with observation and local wound care for 1 year, 1 patient required removal of the exposed mandibular hardware and had successful reconstruction of the condyle with a fibular free flap.

COMMENT

A wide range of condylar prostheses are commercially available. The Christensen prosthesis, which has been in use for more than 25 years, comprises a metal fossa and a metal condyle with an articulating dome of polymethylmethacrylate. It has been shown to be effective in treat-
ing patients with severe TMJ disorders, resulting in significantly reduced pain and improved function in 85% to 90% of patients. However, the use of polymethylmethacrylate can result in more fibrosis, sometimes with reactive cartilage, neo-ossification, or heterotopic and reactive bone formation.

Recently approved by the Food and Drug Administration, a custom-made total joint prosthesis (TMJ Concepts [formerly Techmedica], Camarillo, Calif) can be manufactured according to the patient’s specific anatomical and morphological characteristics. The device has worked very well for TMJ reconstruction in 56 patients, with significant improvement relative to pain, occlusal stability, and function. However, to our knowledge, no studies to date have investigated the usefulness of this device in patients with tumors.

Using the THORP system, Raveh et al reported successful condylar reconstruction in 2 patients: one underwent a hemimandibulectomy and irradiation for treatment of osteosarcoma 10 years previously; the other had an untreated fracture 5 years previously that resulted in ankylosis. Follow-up examination showed unpaired occlusion, correct function and guidance of the joint, and no lateral deviation during opening. The major advantages of the THORP system are the stable anchorage of the carrier plate to the mandible by hollow screws and the 3-dimensional adaptability of the condylar prosthesis after fixation of the plate to the mandible. These features allow the condyle to articulate with the glenoid fossa and to reproduce the normal rotational and translational movements of the condyle. With the THORP system, the advent of osteointegrating screws that lock to the reconstruction plate appears to have significantly reduced the risk of loosening hardware. The THORP system led to the development of the locking reconstruction plate/screw system. This system simplifies the locking mechanism between the plate and screw, eliminating the need for expansion screws.

Development of new alloplastic implants (eg, the THORP system) that provide long-term rigid fixation by the process of osseointegration has led to a renewed interest in the application of mandibular plates for the rehabilitation of patients with head and neck tumors. Kim and Donoff used AO plates to reconstruct the mandibular condyle and ramus after malignant tumor ablative surgery (n=13). Only 1 patient required revision or plate removal because of infection. Other experiences with attempted condylar reconstruction using metallic implants have been disappointing. In 1 series (n=5), the use of titanium mandibular reconstruction plates after excision of advanced malignant tumors resulted in a moderately high failure rate. As in our study, the majority of plate losses occurred in patients who had undergone irradiation. In another series, 2 plates were removed totally or partially owing to extrusion in 4 patients who underwent hemimandibullectomy with disarticulation of the TMJ and immediate reconstruction with titanium AO plates. Lindqvist et al performed 23 TMJ arthroplasties using metallic condylar prostheses, including 9 for segmental mandibular resections in tumor surgery. A clinical and radiological follow-up study showed heterotopic bone formation in 52% of cases and glenoid fossa resorption in 43%. In 1 patient, the condyle eroded through the skull base 10 months after surgery. Thirty percent of prostheses were removed and/or replaced during the average 27.6-month follow-up. Other authors have also reported glenoid fossa resorption with displacement of the prosthesis in the middle cranial fossa.

Alloplastic condylar prostheses may fragment or mechanically break down, resulting in production of implant debris in the joint. A foreign body response directed against this debris contributes to heterotopic bone formation.
formation and progressive bony degeneration. Proplast, polytetf, and Silastic implants are known to cause a severe foreign body giant cell reaction, bone and soft tissue destruction, reactive bone, and migration of microparticulate debris to other body areas, initiating or exacerbating connective tissue and autoimmune disease problems. These processes can produce symptoms of pain, alteration in occlusion, and mandibular hypomobility. Magnetic resonance imaging is useful in detection and evaluation of destructive complications that may accompany failed Proplast and polytetf implants. Because these implants are associated with unfavorable outcomes, they are no longer indicated for condylar reconstruction.

In summary, possible complications of condylar reconstructive surgery using alloplastic implants include the following: temporary or permanent facial nerve weakness; middle ear infections; temporary or permanent hearing loss; tinnitus; dysequilibrium; malocclusion; infection; exposure or extrusion of the prosthesis; development of adhesions or ankylosis within the joint space, causing trismus; displacement, fragmentation, and/or loosening of prosthetic components; heterotopic bone formation; bony erosion of the skull base, with herniation of the implant into the middle cranial fossa; foreign body reaction; and rejection of the implant.

In agreement with our results, plate exposure is the most common cause of reconstructive failure in patients who undergo placement of condylar prostheses after mandibular resection for tumor. An increased incidence of plate exposure has been noted to occur in those patients who require extensive soft tissue resection or radiation therapy. While the pectoralis myocutaneous flap has been the most widely used method of soft tissue reconstruction in this setting, the long-term effect of gravity on the flap pedicle, combined with the opposing action of jaw motion, may increase the risk for wound dehiscence and plate exposure. External plate exposure in lateral mandibulectomy defects may also result from wound contracture that results from the dead space that is normally occupied by bone medial to the reconstruction plate. The process results in mediationalization of the overlying skin and eventual pressure necrosis. This concept is supported by the observation that external plate exposure is not usually seen in patients in whom mandibular reconstruction plates are used for rigid fixation of vascularized bone grafts.

Radiation therapy may play an important role in plate exposure. However, most patients who undergo treatment of advanced carcinomas that require hemimandibulectomy will require combined therapy that includes radiotherapy. There is a higher incidence of wound dehiscence and revision of plates in patients who have undergone irradiation than in those who have not undergone irradiation. Some authors have expressed concern about using postoperative radiation therapy in patients with titanium plates, as the plates might create hot spots that could contribute to breakdown of the overlying skin and eventual exposure of the prosthesis.

Use of any alloplastic material to replace the condyle may be inadvisable given our experiences and those of others. Several biologic reasons speak for autogenous transplant, and there seem to be few reasons for abolishing this concept. Removal of implant, joint debridement, and placement of pedicled temporalis muscle/fascia flap to line the glenoid fossa have been shown to be effective in controlling pain and improving jaw motion in patients with failed alloplastic TMJ implants. The temporalis muscle flap can also be brought down to provide a soft tissue bed in which the delicate cartilaginous cap of a osteochondral rib graft can function. The nonvascularized osteochondral graft has proved to be a significant advance in reconstruction of the condyle in children, particularly in those with acquired deformities.

Autologous grafts, especially free bone grafts, such as the osteochondral rib graft, are often susceptible to unpredictable resorption. For this reason, vascularized bone grafts are being used more widely for mandibular reconstruction. Vascularized bone is also resistant to infection and extrusion, and it can survive in a poor recipient bed resulting from prior irradiation. Various types of such grafts are described in the literature, but the most satisfactory results, both aesthetic and functional, have been achieved with the use of the iliac crest and fibular free flaps. Rivas et al used iliac crest or fibula vascularized bone grafts in 7 patients to reconstruct condylar defects due to resection for oral neoplasm. They reported minimal donor site morbidity and good functional results. According to Urken et al, the internal oblique–iliac crest osseomyocutaneous free flap is most ideal for mandibular reconstruction, especially as its natural shape simulates that of the patient's mandible, thereby reducing the contouring of the neomandible. Criticism of free flap reconstruction of the mandible has focused on the additional operative time required to perform microvascular tissue transfer, as well as on the donor site morbidity that results from harvest of bone-containing flaps. However, the use of the vascularized bone graft for condylar reconstruction after jaw resection for malignant disease has been reliable, with minimal long-term morbidity thus far. Nevertheless, the role of the vascularized bone graft needs to be better established in the treatment of condylar defects after ablative tumor surgery.

Many surgeons delay bony reconstruction of the mandible until overlying soft tissue satisfactorily heals and the patient is free of recurrent disease. However, wound contraction, fibrosis, and sometimes radiation distort tissues and make delayed reconstruction difficult. Facial nerve injury is also more likely. Furthermore, because many patients with advanced tumors of the head and neck have a poor prognosis, it is important to achieve immediate reconstruction, allowing patients a rapid functional and aesthetic recovery. Immediate mandibular reconstruction at the time of ablative surgery also provides patients with less change in appearance and self-esteem, which in turn improves the likelihood of the resumption of normal social activities. One study showed no significant difference in the failure rate between immediate reconstruction and delayed reconstruction of the condyle using AO plates.

Further research is essential in determining any benefit from delayed reconstruction of the condyle after tumor resection and in seeking alternative prosthetic re-
placements, especially in patients who are medically or surgically unsuitable for vascularized bone reconstruction.

**CONCLUSIONS**

Metallic condylar prostheses in the setting of tumor resection and reconstruction involve significant risks and potential complications, and they do not give a satisfactory result. Autogenous materials, such as the vascularized bone graft, should be used whenever possible.

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**REFERENCES**