clinical reviews

Restricted Mouth Opening in Head and Neck Cancer: Etiology, Prevention, and Treatment

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abstract

Restricted mouth opening or trismus is often encountered in patients with head and neck cancer. The restriction may be the presenting sign of malignancy, a sequela of tumor site or growth, an adverse effect of oncologic treatment, or a first sign of tumoral recurrence. In general, any insult to the temporomandibular joint, masticatory muscles, or their neural innervation may cause limitation in mouth opening. The etiologies leading to trismus are as follows: myospasm secondary to tumor infiltration; reflectory myospasm; radiation-induced myositis and myofibrosis; temporomandibular joint involvement with tumor; unfavorable postsurgical scarring; muscle and joint atrophy secondary to immobilization; pain; jaw fracture and hardware failure; and infection. Preventive measures should be implemented before, during, and after treatment. These measures include identification of high-risk patients, utilization of dose-sculpting radiation techniques whenever possible, performing reconstruction at the same time of resective surgery whenever feasible, and initiating mobilization exercises as early as possible. When trismus develops, treatments are often challenging and disappointing. These include physical therapy, mouth opening appliances, drug therapy, and release surgery. All medical specialties dealing with head and neck cancer should be familiar with the diagnosis and prevention of trismus and make an effort to ensure patients are referred to the appropriate care when needed. Trismus should not be considered a trivial sequela of head and neck cancer.

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INTRODUCTION

Restricted mouth opening, usually referred to as trismus or jaw hypomobility, is often encountered in patients with head and neck (HN) cancer.[1,2] The reported prevalence in the literature varies in different studies from $< 10\%$ to $> 50\%$ of patients. This wide range depends on tumor site, size, and oncologic treatment; it is also attributed to study design, assessment methods, and the diagnostic criteria used.[3-8]

Restricted mouth opening adversely affects patients' health and quality of life. Eating, oral hygiene, talking, and other social interactions are compromised to various degrees. In addition, oral access for dental care and oncologic surveillance may become limited to different extents.[6,7,9] The ability to secure the airway in the setting of restricted mouth opening is significantly impeded, and the risk of aspirations is notably increased.

Trismus may occur as a presenting sign of malignancy, as a sequela of tumor site or growth, as an adverse effect of oncologic treatment, or as a first sign of tumoral recurrence. Family practitioners, otolaryngologists, oncologists, oral and maxillofacial surgeons, oral medicine specialists, dentists, neurosurgeons, plastic surgeons, and doctors in pain medicine may all be actively involved in the detection, prevention, and treatment of trismus. Other health care providers such as nutritionists, physiotherapists, and speech therapists should also be familiar with the clinical manifestations of trismus, the available preventive measures, and the possible therapeutic options and should make an effort to ensure patients receive the appropriate care when needed.

Clinicians treating patients with HN cancer encounter restriction of jaw mobility on a daily basis, but it should not be considered a trivial sequela of HN oncologic therapy.[10] Care providers should be aware of its causes and make an effort to apply all preventive measures available to minimize the restriction and offer appropriate care when applicable. The purpose of this article is to present an overview of the different etiologies leading to trismus in patients with HN cancer and discuss the preventive and therapeutic options available.

STRUCTURE AND FUNCTION OF THE MASTICATORY SYSTEM

The primary components of the masticatory system are the fixed upper jaw (maxilla); mobile lower jaw

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(mandible); teeth, which articulate the maxilla to the mandible; 2 temporomandibular joints, which join the mandible to the skull base; muscles of mastication; and vascular and nervous systems supplying these tissues.

There are 4 muscles responsible for closing the jaws; these are the masseter, temporalis, medial pterygoid, and superior head of lateral pterygoid (Fig 1A). These muscles are innervated by the mandibular division of the trigeminal nerve and function in elevating the mandible. Opening the jaw is performed by the inferior head of the lateral pterygoid muscle and the mylohyoid, digastric, stylohyoid, and geniohyoid muscles. For these muscles to depress the mandible, the infrahyoid muscles consisting of the sternohyoid, sternothyroid, thyrohyoid, and omohyoid function to stabilize the hyoid bone to facilitate jaw opening (Fig 1B).

Normal mouth opening is 40 to 50 mm measured between the upper and lower incisor teeth. Normal lateral and protrusive excursions of the mandible are 8 to 10 mm. Many authors propose a 30- to 35-mm cutoff point where less than this value is considered a restricted mouth opening. Others propose a gradual definition of trismus in which the restriction is classified as mild, moderate, or severe, depending on the magnitude of mouth opening.[4,6,11]

ETIOLOGY OF TRISMUS

Historically, the Greek word trismós was used to describe the rigid muscular contractions causing grinding and clenching of jaws associated with tetany patients. Nowadays, it is used to describe restricted mouth opening in general, regardless of etiology and independent of whether muscle spasm or pain is absent or present.

Generally speaking, any insult to the temporomandibular joint, masticatory muscles, or their neural innervation may cause trismus. The insult may be secondary to tumor location or infiltration or an adverse effect of

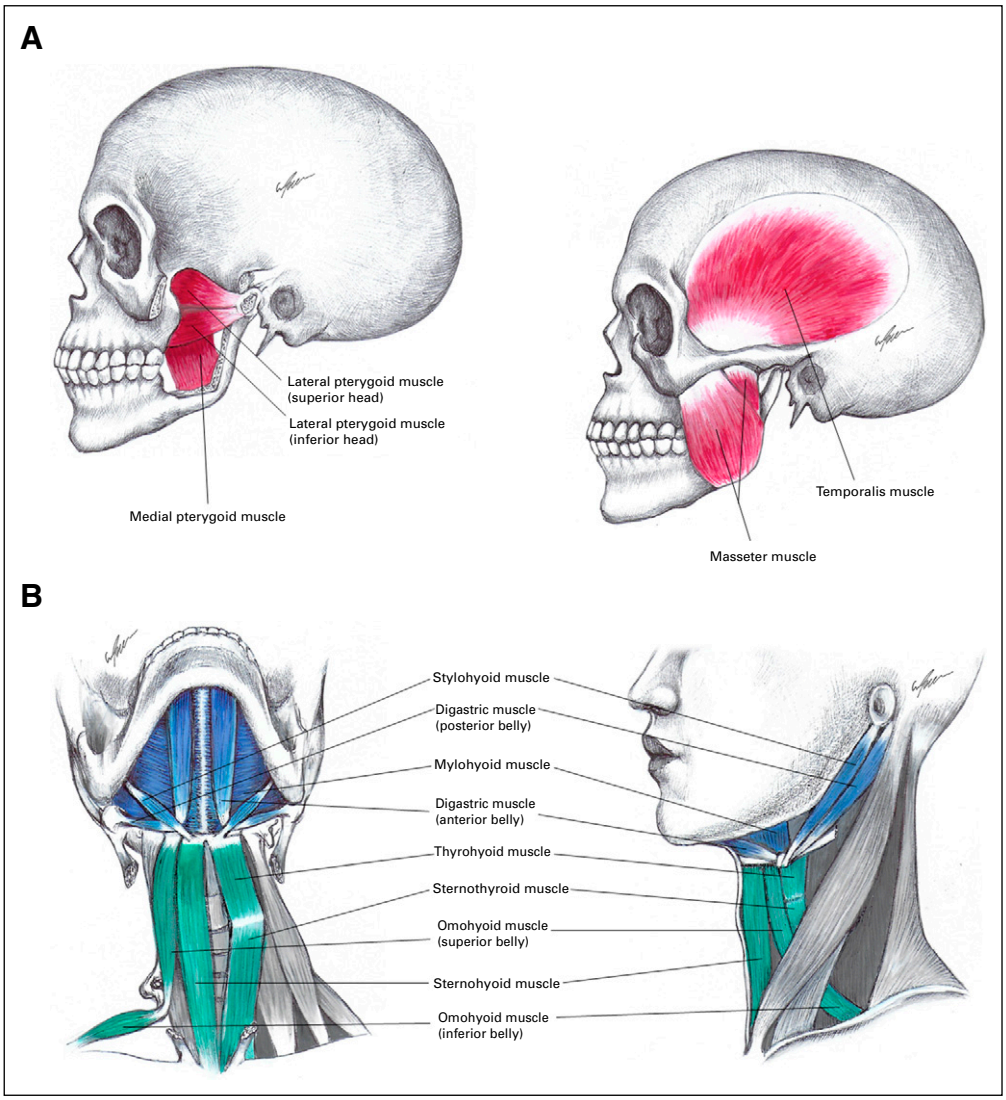

FIG 1. (A) Jaw-closing muscles: masseter, temporalis, medial pterygoid, and lateral pterygoid muscles. Note that the superior head of the lateral pterygoid functions as an elevator of the mandible (jaw closing), whereas the inferior head functions as a depressor of the mandible (jaw opening). (B) Jaw-opening muscles are classified into the suprahyoid muscle group, including the mylohyoid, digastric, stylohyoid, and geniohyoid muscles (the geniohyoid lies deep to the mylohyoid muscle and is not depicted in this illustration), and the infrahyoid muscle group, including the sternohyoid, sternothyroid, thyrohyoid, and omohyoid muscles.

therapies affecting these areas. Trismus can also be a protective reaction to pain.[6,7,12-14] Following is a description of the etiologies of trismus in patients with HN cancer.

Myospasm Secondary to Tumor Infiltration

Tumors adjacent to the masticatory muscles may infiltrate the surrounding fascia and muscle tissue and cause reflex spasms.[6,7] The tumor may be a primary HN cancer or a metastatic cancer to the HN area. The sustained muscle contractions cause trismus, which is usually associated with pain. The pain may be localized to the tumor site or radiate to distant areas. Although lesions of the oral cavity are readily detectable on clinical examination, deep tumors of the infratemporal fossa and parapharyngeal space may initially manifest with limited mouth opening mimicking a temporomandibular disorder rather than a neoplasia (Fig 2).[15]

Reflectory Myospasm

The mandibular division of the trigeminal nerve carries motor neurons to the muscles of mastication and sensory neurons from the oral mucosa and facial skin. Tumors infiltrating the branches generate sensory impulses directed centrally to the trigeminal nucleus, which can be perceived as pain. Consequently, motor impulses are generated from the trigeminal nucleus to the periphery, increasing the tonus of the masticatory muscles, activating a tonic reflex arch, and causing a so-called reflectory trismus.[2,6,16,17] This ectopic activity of the trigeminal nerve with its resultant involuntary spasm of muscles and ultimate contracture of tendons and ligaments contributes to the development of trismus in patients with HN cancer (Fig 3).

Temporomandibular Joint Involvement With Tumor

Primary or metastatic tumors of the temporomandibular joint may cause destruction of articular structures, rendering the joint incapable of rotating and translating normally. The neoplasia may directly involve joint structures or affect these structures secondarily to condylar neck involvement with neoplasia (Fig 4).[18-20]

Radiotherapy

Radiation therapy is one of the primary causes of trismus in patients with HN cancer, and the prevalence of restricted mouth opening in this patient population is reported to be between 30% and 50%.[8,21-23] The higher the radiation dose delivered to the masticatory structures, the worse is the restriction in mouth opening. Levels in excess of 60 Gy are more likely to cause trismus; patients who were previously irradiated and are currently being treated for recurrence are at a higher risk of trismus than patients receiving their first treatment.[6,24] Tumors arising in close proximity to masticatory structures increase the risk for postradiation trismus. Thus, cancers of the oral cavity, oropharynx, nasopharynx, jaws, and salivary glands carry an increased risk of trismus compared with tumors of the hypopharynx, larynx, and skull (Fig 5).[6,21,22,25]

Clinical research studies, as well as systematic reviews of the literature, reported an approximate 20% to 30% decrease in mouth opening after regular therapeutic doses of radiotherapy.[6,11,26,27] The diminution of mouth opening usually begins to appear toward the end of the radiation course and continues to deteriorate in the following year or so.[7] However, the restriction may begin at any time during the first or second year after radiation, and in general, most of the reduction occurs in the first 1 to 2 years.[27]

The pathobiology behind radiation begins with focal myopathy of the irradiated muscles, usually associated with painful spasms. This is followed by abnormal proliferation of fibroblasts in the muscles and ligaments, a process called radiation-induced fibrosis.[5,7,9] The fibrotic change continues for several months and causes

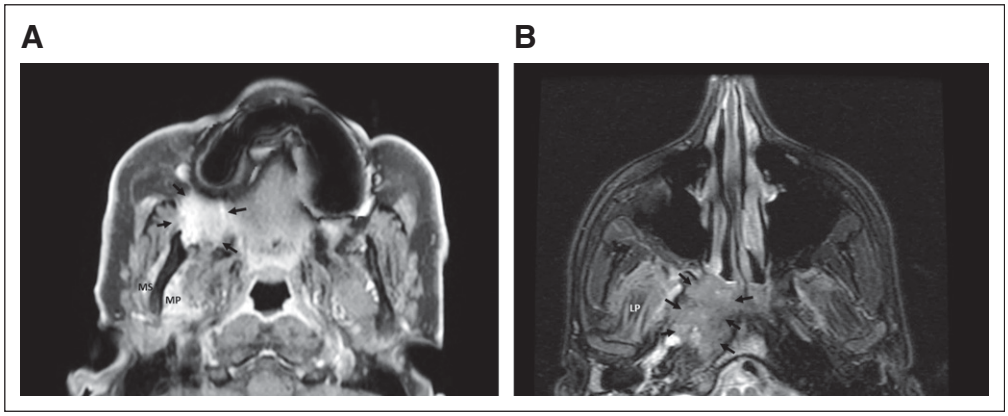

FIG 2. (A) Gadolinium-enhanced T1-weighted magnetic resonance imaging (MRI) scan in the axial plane demonstrating a squamous cell carcinoma (arrows) of the right retromolar trigone infiltrating the medial pterygoid (MP) and masseter (MS) muscles. (B) Fat-saturated T2-weighted MRI scan in the axial plane demonstrating a nasopharyngeal carcinoma (arrows) infiltrating the lateral pterygoid muscle (LP) and infratemporal fossa.

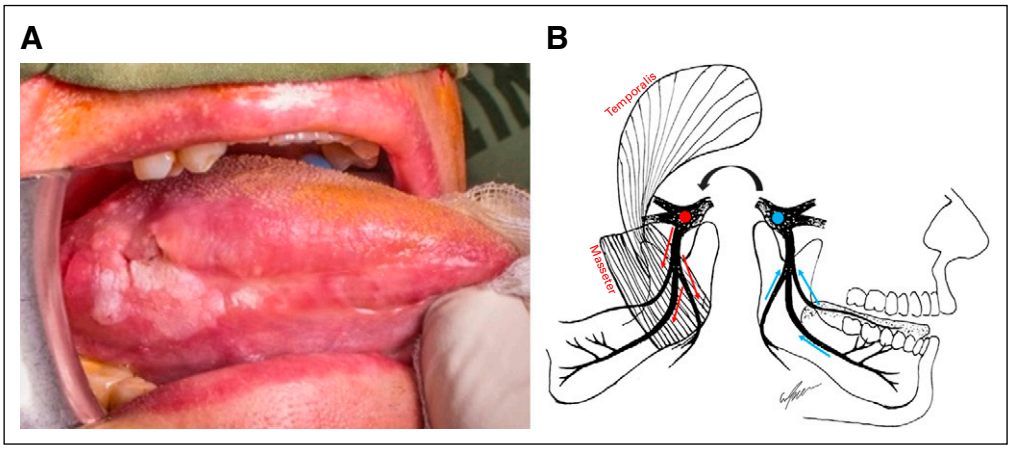

FIG 3. (A) Squamous cell carcinoma of the tongue presenting as an ulcer and manifesting with significant trismus even though there was no extension of the tumor into the masticatory muscles. (B) Illustration of the reflex arch of the trigeminal nerve. The afferent fibers and sensory nucleus are depicted in blue, whereas the efferent fibers and motor nucleus are depicted in red.

shortening and contracture of tissues, further worsening the trismus. The combination with regional loss of vascular perfusion further exacerbates these effects. According to several studies, concomitant chemotherapy and radiotherapy may be associated with a higher prevalence of trismus.[7-9]

As treatment outcomes in HN cancers improved, the concerns of the radiation community shifted toward decreasing the disabling long-term adverse effects of radiation to organs in proximity to the irradiated target volume. In the past, 2-dimensional and, later, 3-dimensional conformal radiation was the main treatment modality. With the use of 3-dimensional conformal radiation, the patient's anatomy is used in planning a radiation dose that conforms to the target volume while minimizing exposure to adjacent normal structures. However, beam setups were usually simple and frequently consisted of opposing lateral fields or a 4-field box design. Recent improvements in imaging technologies and beam sculpting have led to the introduction of intensity-modulated radiotherapy (IMRT) and image-guided radiotherapy (IGRT). IMRT allows for the radiation dose to conform more precisely to the tumor's 3-dimensional shape, modulating nonuniform radiation beam intensities to deliver higher radiation doses to the tumor while further minimizing the dose to surrounding normal tissues.[28] IGRT is a technique that is often used in combination with IMRT, allowing for daily on-board imaging before treatment delivery for reduction of the margins needed to account for tumor motion and setup error.

The use of these advanced photon delivery techniques and the introduction of proton-based radiation therapy seem to have lowered the severity and frequency of radiation-induced trismus.[6,9,23,29-31] In a systematic review, Bensadoun et al[9] reported the prevalence of trismus to be 25.4% in patients who received conventional radiotherapy and 5% for the few IMRT studies.

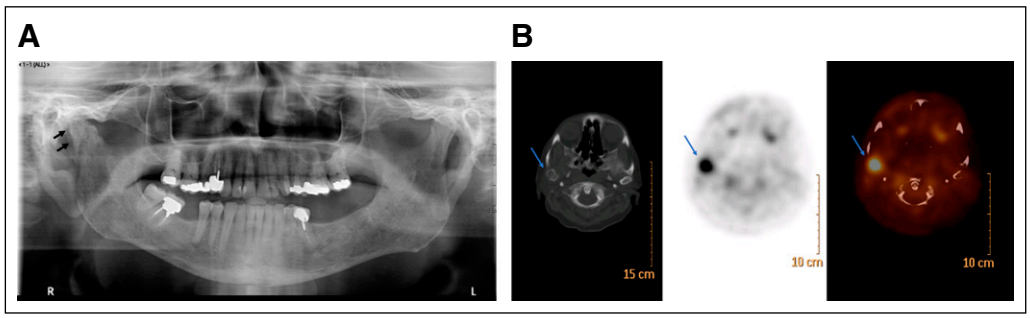

FIG 4. (A) Panoramic radiograph demonstrating involvement of right mandibular condyle (arrows) with multiple myeloma causing fracture and collapse of the condylar head and neck. The left condyle is intact. (B) Breast cancer metastasis to the right temporomandibular joint (arrows) as evidenced on positron emission tomography–computed tomography. Both patients in panels A and B suffered from restricted mouth opening, and the diagnosis of temporomandibular joint involvement with tumor was evident only after imaging.

Unfavorable Scarring

Ablative procedures, whether minimal and localized or broad and extensive, may be associated with various degrees of scarring and tissue contracture. Reconstruction of defects may minimize these effects; however, some degree of limitation may still occur. For example, secondary healing after resection of the buccal mucosa carries a risk of formation of a fibrotic band connecting the upper and lower jaws and limiting mouth opening (Fig 6A). Reconstruction of the defect by buccal fat pad lowers the chances of this adverse effect.

Surgical approaches through the temporalis muscle to gain access to the infratemporal fossa, the posterior wall of the maxillary sinus, or the temporal lobe of the brain may restrict mouth opening. Surgical approaches in which the muscle is dissected rather than transected decrease this risk (Fig 6B).[32,33]

Muscle and Joint Atrophy Secondary to Immobilization

Sustained mandibular hypomobility leads to muscle and joint degeneration.[9] Muscles show signs of atrophy and joints show cartilage thinning as early as few days after immobilization.[6] The cause of diminished mobility may be the radiation therapy, neurotoxic chemotherapy, postsurgical morbidity, or the patient's preference to limit mouth opening as a result of aesthetic concerns or speech and eating problems. Regardless of etiology, immobilization eventually leads to degeneration of joint surfaces and shortening and atrophy of muscles, leading to restriction on range of motion (Fig 7).[6,34]

Pain

In the presence of pain, the reduction in range of motion and the decreased ability to move the mandible are considered adaptive mechanisms intended to prevent further damage and promote healing. Oral pain is reported in up to 85% of patients with HN cancer at the time of diagnosis.[35] Regardless of whether the etiology of pain is radiation, surgery, or the neoplasia itself, the limitation in range of motion is a normal central protective adaptation intended to prevent further pain and damage.[12,36,37] The American Academy of Orofacial Pain defined protective splinting or trismus as follows: "A restricted or guarded mandibular movement due to co-contraction of muscles as a mean of avoiding pain caused by movements of the parts."[37a(p279)] The phenomenon of protective co-contraction in which the restriction is not a primary dysfunction but a normal central protective adaptation was first proposed by Lund in 1991.[36,38]

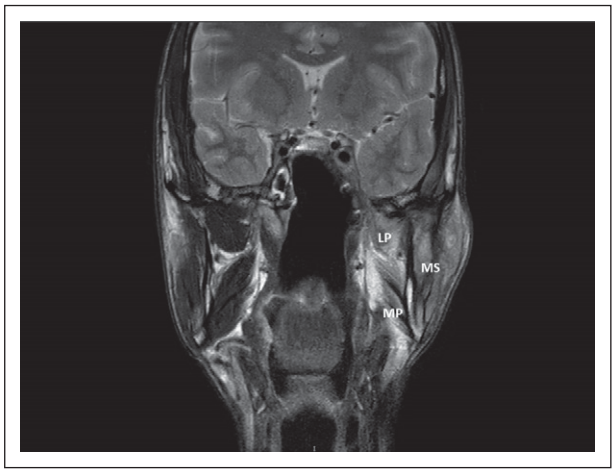

FIG 5. T2-weighted magnetic resonance imaging scan in the coronal plane showing the effects of radiation evidenced as hyperintense signal in the left medial pterygoid (MP), lateral pterygoid (LP), and masseter (MS) muscles. This scan was performed a few months after the termination of radiation treatment. The patient suffered from severe trismus.

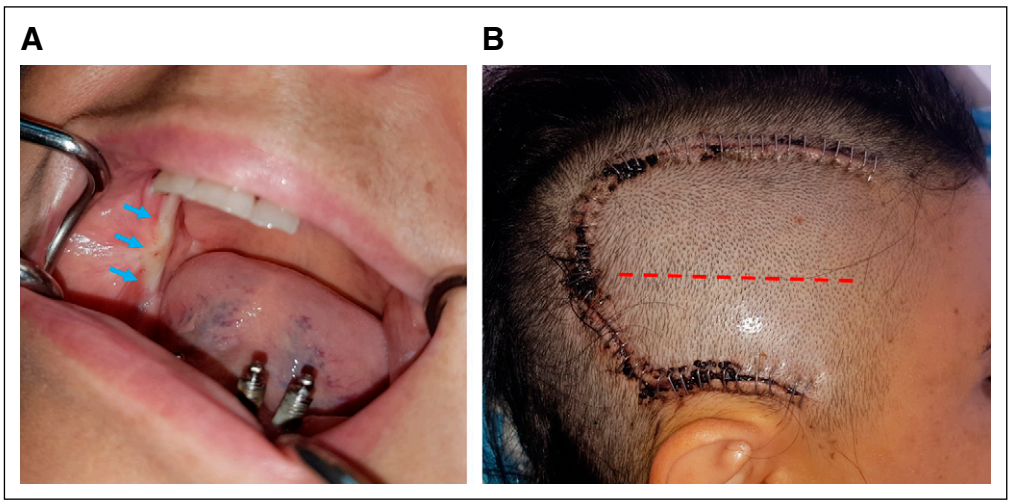

FIG 6. (A) Fibrotic band of scar tissue (arrows) developed after resection of the buccal mucosa and no reconstruction (secondary healing). The patient suffered from painless limitation of mouth opening. (B) Surgical approach to gain access to the temporal lobe of the brain dissecting the temporalis muscle. Approaches transecting the temporalis muscle (dashed line) carry an increased risk of myospasm and trismus.

FIG 7. Temporal hollowing due to atrophy of the temporalis muscle. The bony orbital rim becomes relatively pronounced and bulgy due to wasting of the temporalis.

Jaw Fracture and Hardware Failure

Iatrogenic and pathologic fractures of the mandible may manifest with restricted mouth opening as the primary complaint. The residual bone after mandibulectomy may be thin, and radiation renders the bone brittle and prone to crack. Similarly, failure and fracture of the reconstructing plates and screws may have a similar clinical scenario. Often, the patient is unaware of the fracture, primarily as a result of the fact that these cracks occur under normal physiologic loading and are generally not traumatic. In these cases, the patient may present with a mere complaint that opening the mouth is limited and associated with acute pain.[39-41] Often, it is only after radiographs are taken that the fractures are diagnosed (Fig 8).

Myospasm Secondary to Infection

Infections spreading to myofascial spaces involving the muscles of mastication usually cause trismus. An acute decrease of mouth opening associated with pain should be considered an infection of the masticatory spaces until proven otherwise. In general, patients with cancer are at an increased risk of infection because of their immunocompromised status, and the local effects of radiation add to this risk as a result of the vascular injury. Most infections in the early postsurgical phase are adverse events of the surgical procedure. Later, the majority of infections in the HN area are of odontogenic origin. The ability to perform intraoral examination in patients with cancer with limited mouth opening is impeded, which limits the ability to detect and proper treat dental pathology. Xerostomia adds to the overall risk of infection and dental decay. Other causes of infection include salivary gland disease, open fracture of the jaw, exposure of fixation plates and implants, and secondary infection of the tumor itself.

PREVENTION OF TRISMUS

It is important to identify patients with risk factors for developing trismus.[42] Once restriction of mouth opening has occurred, treatments generally fail to regain the original range of motion. There are several levels of preventive measures.

Radiation

Ideally, radiation affects the target volume with no to minimal effects on the surrounding tissue and structures, and radiation oncologists aspire to this goal. The use of dose-sculpting techniques such as IMRT and daily IGRT decrease radiation to adjacent structures without compromising the required therapeutic dose.[23,29,31] These technologies, however, are not always available or capable of sparing the structures involved in jaw opening as a result of involvement of these structures with cancer or concerns about the presence of microscopic disease in these regions that necessitate them to be included in the irradiated field.

Fabricating a splint to wear during radiotherapy is a simple and effective tool that can be easily made in the dental office and could be suitable for many tumors. These splints are usually made of silicone impression materials and aim to separate the upper and lower jaws, so that the healthy jaw is held away while the other jaw is radiated, thus minimizing the radiation delivered to the healthy jaw. Similarly, these splints can simultaneously press the buccal mucosa and soft tissues laterally and the tongue to the contralateral side so that these structures are also held away from the radiation. These relatively simple measures facilitate conformal radiotherapy to the desired compartment while sparing uninvolved sites.

Surgery

Along with resection of the tumor, surgeons should apply certain intraoperative measures to minimize trismus. In the case of tumors in the mandibular ramus area, temples, or the cheek bones, consideration should be given to perform prophylactic resection of the adjacent coronoid process—the insertion point for the temporalis muscle (Fig 9). The

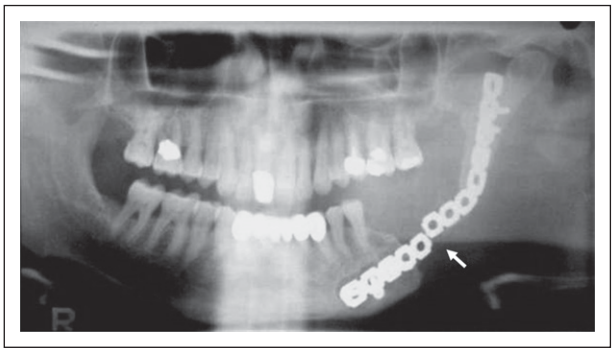

FIG 8. Panoramic radiograph showing a fractured reconstruction plate (arrow) in a patient who underwent segmental mandibulectomy as a result of osteogenic sarcoma. The patient complained of difficulty and tenderness upon opening the mouth. Clinical examination failed to reveal a pathology, and the fractured plate was diagnosed only after the radiograph was taken.

fibers of this relatively large and strong jaw-closing muscle carry a risk of fibrosis and contracture secondary to surgery, radiation, or immobilization.[32] In addition, cutting the insertion of the ipsilateral masseter and medial pterygoid muscles further decreases the chances of myofibrotic contracture of these jaw-closing muscles.[43]

Immediate reconstruction should be preferred whenever feasible. Unreconstructed surgical defects carry an increased risk of scarring and fibrosis, and delayed reconstructions generally require larger efforts with often inferior outcomes.[14] Unreconstructed bony segmental defects carry an increased risk of fracture of the supporting metal plates and screws.

Physical Therapy

Patients at risk for developing trismus should be educated that once trismus has developed, it is often not feasible to reverse the condition. Even minor increases in mouth opening may require major therapeutic efforts with often less than satisfactory results. Patients should be informed that their cooperation with preventive and rehabilitative exercises is important to the success of treatment. The primary aim of postsurgical physical therapy is to mobilize the masticatory structures to prevent secondary contracture, fibrosis of muscles, and degeneration of joints.[3,7]

Dental Care

Every effort should be made to minimize the risk of odontogenic infections. Patients should undergo a thorough dental evaluation as soon as possible after the diagnosis of cancer. Ideally, all potential sources of dental and periodontal infection are eradicated before the initiation of oncologic therapy. Extraction of hopeless teeth should be performed at least 4 to 6 weeks before the start of radiotherapy to minimize the risk of osteoradionecrosis.

Patients should be given clear oral hygiene instructions including individualized recommendations regarding the use of specific dental appliances. Patients who are at risk for developing xerostomia should receive fluoridation in the dental office and be educated about the use of artificial saliva products and sugar-free candies to stimulate salivary flow.

TREATMENT OF TRISMUS

There are few studies evaluating treatment of trismus in patients with HN cancer. The therapeutic recommendations lack a broad scientific basis and are based on clinical experience and good clinical practice.[4,44] Accurate diagnosis before initiating treatment is mandatory. Treating clinicians should be able to differentiate between trismus that is a sequela of previous oncologic therapy and trismus that is a first sign of recurrence.[6] Multimodal therapy should always be considered to achieve better results. Caregivers must bear in mind that the condition may worsen over time, regardless of treatment, or improve over time, even in the absence of therapy.[6,9]

Physical Therapy

Although the evidence for the effectiveness of physical therapy to ameliorate trismus in patients with cancer is poor, it is widely regarded as the mainstay of therapy and the first-line treatment.[6,45] There is no agreement in the literature as to when to start physiotherapy. Although some authors have initiated exercises during the radiation therapy,[6,7] others have recommended starting physical therapy soon after finishing radiation treatment.[6] However, all authors agree that delaying physical therapy for a year or so after oncologic treatment lowers the chance of achieving satisfactory results.[9] When the oncologic treatment includes surgery only, physiotherapy should start as soon as practical.[35]

Mobilization exercises should be the primary component of physical therapy programs.[6,9,46] Active exercises in which patients use their own musculature to perform movements in their greatest range of motion possible and passive exercises in which external forces are applied to stretch the muscles of mastication should be administered. Whereas active exercises aim to strengthen the jaw-opening muscles (depressors of the mandible), passive exercises stretch the jaw-closing muscles (elevators of the mandible; Fig 10).

Heat therapy, microcurrent electrotherapy, low-level laser therapy, and other complementary techniques could be used to improve circulation, relieve pain and discomfort, increase extensibility of collagen tissue, decrease joint stiffness, and facilitate easier mobilizations. Reports of their potential efficacy in improving trismus have been proposed; however, future studies are still needed to establish their actual added benefit.[47-51]

Clinicians should measure mouth opening regularly and set a realistic goal for the patient. After achieving the planned

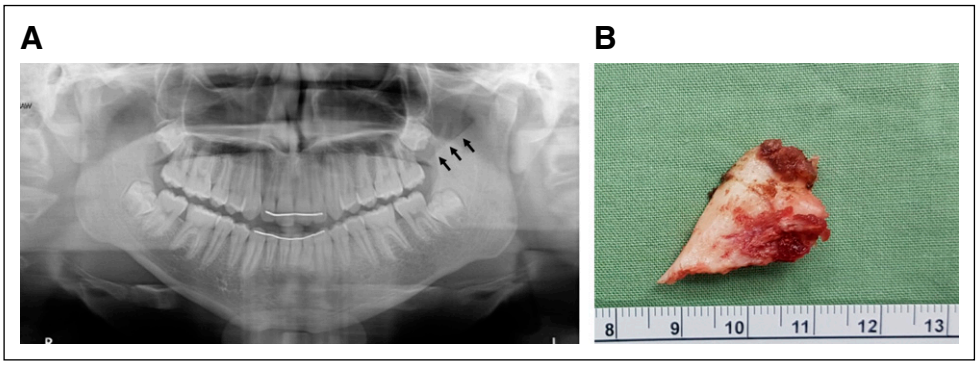

FIG 9. (A) Panoramic radiograph showing a mandible after resection of the left coronoid process (arrows). The right coronoid is intact. (B) The resected specimen. Note the residual temporalis muscle fibers attached.

range of motion, self-exercises should be continued for 1-2 years to maintain the results.

Trismus Appliances

Various appliances have been described to treat trismus. These appliances impart mechanical forces to forcibly stretch the jaw-closing muscles by depressing the mandible, so their primary mode of action is similar to passive physiotherapy exercises.[7] The most commonly used techniques are the stacked wooden spatulas pried between upper and lower teeth and used as a wedge and the threaded-tapered screw (corkscrew), which is gradually turned and forces the maxillary and mandibular teeth apart (Fig 10).[9] These techniques can be applied continuously or intermittently, with varying degrees of force, determined by the patient. Alternatively, these appliances can be used in an active form; patients open the mouth actively using their own jaw-opening muscles, the appliance is inserted, and the number of spatulas or coils is counted. This helps the patient to set goals and record progress.[6] The primary disadvantage of these techniques is that their use is limited to dentate or partially edentulous patients; significant forces may be generated on the teeth, which can predispose them to loosening and pain. There are no studies in the literature that have demonstrated significant improvement in treating trismus with wooden spatulas or tapered screws.[6,9] Other commercially available appliances include the TheraBite system (Atos Medical, Malmo, Sweden) and Dynasplint System (Dynasplint Systems, Severna Park, MD). Few studies have demonstrated their efficacy in improving mouth opening.[21,45,52-54] Both systems impart force on the lower jaw and passively stretch the jaw-closing muscles. The force in TheraBite is intermittent and controlled manually by the patients' hands, whereas the force in Dynasplint is continuous.

Drug Therapy

Analgesics, anti-inflammatory medications, and muscle relaxants should be prescribed at the initial phase of physical therapy. Pain control and muscle relaxation improve the quality of physical therapy exercises and increase the compliance with the rehabilitation program.

Botulinum toxin injection was reported to alleviate pain in postradiation trismus, probably by decreasing the painful spasms of myopathic muscles. It could be considered as an adjuvant therapy for radiation-induced trismus. Similarly, cannabis has been reported to help alleviate muscle spasms and pain. However, neither botulinum toxin nor cannabis has been shown to improve trismus or increase mouth opening.[6,55-60]

Pentoxifylline was reported to show some benefit in radiation-induced trismus. It is a methylxanthine derivative that improves tissue oxygenation and influences cytokine-mediated inflammation. Although some authors have reported beneficial effects with this drug, others have reported it to be ineffective for radiation-induced trismus.[6,61,62]

Release Surgery

Myofibrotic contracture of masticatory muscles, whether caused by radiation, surgical scarring, or immobilization, may

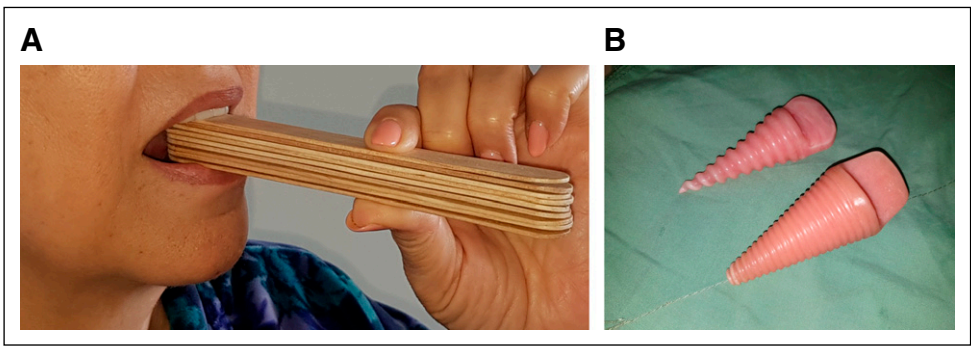

FIG 10. (A) Wooden spatulas are stacked up and used as a wedge between upper and lower teeth to increase mouth opening passively. (B) The threaded-tapered screw may be fabricated in different sizes with varying pitch distance between the threads.

be overcome by muscle myotomy. In the case of the temporalis muscle, coronoidectomy could be considered.[6] Resection of scar tissue and fibrotic bands along with reconstruction of surgical defects can alleviate some of the restriction and improve trismus.[14,32] All release-reconstructive surgeries must be followed by strict physical therapy programs; patients selected for these types of surgeries should be cooperative and well motivated.

Forced mouth opening under general anesthesia has been reported. The rationale is to gain an immediate increase in range of motion that is then maintained by intensive physiotherapeutic exercises combined with pharmacologic measures. However, the effect is usually short lived, and the procedure may be complicated by jaw and alveolar ridge fractures and soft tissue injuries.[6,9]

Control of Infection

Trismus is an ominous sign in the oncologic patient suspected of odontogenic infection. An assessment of current or impending airway obstruction should be the first step in the clinical evaluation. A measurement of the maximal mouth opening should be made and compared with the baseline values documented in the medical file. The degree to which the infection adds to the restriction should be determined.

Patients with cancer generally have immune system compromise and fewer systemic reserves. Thus, treatment should include close monitoring, frequent evaluation of airway, broad-spectrum antibiotics, medical support, nutritional support, and incision and drainage.

In conclusion, restricted mouth opening is a common finding in patients with HN cancer. It has profound effects on the physical, psychological, and social status of the patients and, ultimately, on their quality of life and overall survival.

Trismus can result from tumor invasion into the masticatory muscles, their neural innervation, or the temporomandibular joints. Alternatively, oncologic treatments affecting these areas can also cause trismus.

All clinicians involved in the treatment of patients with HN cancer should be actively involved in the diagnosis, prevention, and treatment of trismus. Patients presenting with restricted mouth opening should be readily detected and quickly referred to the appropriate setting of care.

Although advances in diagnostic modalities, reconstructive surgeries, and radiation techniques have lowered the prevalence and severity of trismus, it continues to affect a large proportion of patients with HN cancer. Despite numerous publications on the topic, the knowledge about prevention and treatment of trismus remains scarce. Future investigation is needed to clarify the optimal management measures to prevent and treat trismus in HN cancer.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Restricted Mouth Opening in Head and Neck Cancer: Etiology, Prevention, and Treatment

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Patents, Royalties, Other Intellectual Property: I have a patent for a medical device in the field of temporomandibular joint arthroscopy (Inst)

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