NECK DYSFUNCTION

HNC and Neck Dysfunction

- Prevalence rates of 0-45% for neck pain in mixed cohorts [Gane, 2017]
- Incidence of neck pain in patients who underwent RND and MRND was 70% at day 1 post-surgery compared to 3% at 2 months post-surgery [Gane, 2017]
- Higher proportion of patients experience neck pain if cervical plexus had been sacrificed compared to preserved [Gane, 2017]
- Patients with history of HNC treatment may experience neck pain or tightness that interferes with daily activities [Shah, 2001]
- Neck pain and dysfunction associated with reduced health related quality of life [van Wilgen, 2004]

HNC and Neck Pain

1 out 3 patients after neck dissection experience neck pain at least 1 year after surgery

- Neuropathic
- Nociceptive

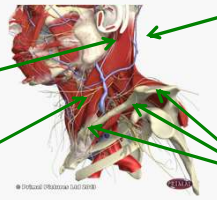
[van Wilgen CP, Dijkstra PU, van der Laan BF, Plukker JT, Roodenburg JL. Morbidity of the neck after head and neck cancer therapy. Head Neck. 2004 Sep;26(9):785-91]

Neuropathic Pain

- Allodynia (light touch): 13%
- Hyperpathia (pin prick): 32%

[van Wilgen CP, Dijkstra PU, van der Laan BF, Plukker JT, Roodenburg JL. Morbidity of the neck after head and neck cancer therapy. Head Neck. 2004 Sep;26(9):785-91.]

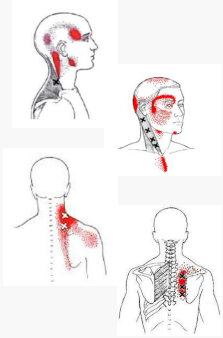
Cutaneous Nerves



Cranial Nerves

Nociceptive Pain

- Myofascial pain [van Wilgen, 2004]
  - *Trapezius: 35%*
  - *Levator scapulae: 46%*
  - *Rhomboids: 31%*
- Myofascial pain [Cardoso, 2014]
  - *20 out of 167 patients (11.9%)*
    - 80.5% of cases involved upper trapezius



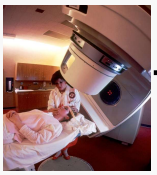
[Cardoso LR et al. Myofascial pain syndrome after head and neck cancer treatment: Prevalence, risk factors, and influence on quality of life. Head Neck. 2015;37:1733-7.]
[van Wilgen CP, Dijkstra PU, van der Laan BF, Plukker JT, Roodenburg JL. Morbidity of the neck after head and neck cancer therapy. Head Neck. 2004 Sep;26(9):785-91.]

HNC and Myofascial Pain

SURGERY

HNC and Neck Pain

RADIATION



National Cancer Institute
Michael Anderson

CERVICAL DYSTONIA

CERVICAL FIBROSIS

Ioannidou-Marathiotou I et al. Int J Gen Med (2010)

Radiation Fibrosis

- Progressive fibrotic tissue sclerosis that results from radiation therapy
- Severity is dependent on:
  - *Radiation dose*
  - *Tissues within radiation field*
  - *Genetics*
  - *Connective tissue disorders*
  - *Diabetes mellitus*
  - *Concurrent systemic therapy*

[Stubblefield MD. Radiation fibrosis syndrome: neuromuscular and musculoskeletal complications in cancer survivors. PM R. 2011;3:1041-54.]

Radiation Fibrosis

- Mechanisms linking radiation to tissue fibrosis is not well understood.
  - *Theory*
    - Radiation causes apoptosis and cell death via DNA damage in tumors and normal tissue
      - *Responses to injury*
        - Activation of coagulation system
        - Inflammation
        - Epithelial regeneration
        - Tissue remodeling
    - Vascular endothelial damage → coagulation / inflammation
      - *Chronic presence of cytokines and inflammatory cells leads to increased fibrin production*

[Stubblefield MD. Radiation fibrosis syndrome: neuromuscular and musculoskeletal complications in cancer survivors. PM R. 2011;3:1041-54.]

HNC and Radiation Fibrosis

Musculoskeletal

- Bone
- Ligament/Joint Capsule
- Muscle
  - *Cervical Dystonia*
  - *Trismus*

Neuromuscular

- Peripheral neuropathy
- Plexopathy
- Radiculopathy
  - *"Drop head" syndrome*
    - Cervical extensor muscle weakness

[Stubblefield MD. Radiation fibrosis syndrome: neuromuscular and musculoskeletal complications in cancer survivors. PM R. 2011;3:1041-54.]

Neck Soft Tissue Fibrosis

- Irradiated area may become thicker in collagen
- Increase in cells containing type I and IIII collagen in upper dermis

↑ tension

↓ elasticity

HNC and Neck Dysfunction: Impaired Cervical Range of Motion

Ghiam et al. 2017

	Mean (SD)	Normative Value
FLX	42.5 (11.9)	50
EXT	49.5 (16.5)	60
L SB	35.0 (13.0)	45
R SB	36.1 (11.0)	45
L ROT	50.7 (14.9)	80
R ROT	48.1 (13.7)	80

At least 3 months s/p surgical resection with reconstruction +/- radiation

- Limited cervical ROM in patients s/p modified radical neck dissection at 2 months [Ahlberg, 2012]
  - *Only cervical rotation significant at 12 months*
- 13% of patients s/p SND demonstrated up to 30 degree side-to-side difference in cervical rotation [Teymoortash, 2010]
- 21% of patients s/p SND demonstrated up to 10 degree side-to-side difference in lateral flexion [Teymoortash, 2010]

Active range of motion of the cervical spine in degrees and standard deviation, classified by age, in patients after radical, modified radical, or selective neck dissection
(n = 153) [van Wilgen, 2004]

Age	Rotation away	Rotation towards	Lateral flexion away	Lateral flexion towards	Flexion	Extension
<40	70 (15)	74 (16)	35 (12)	35 (11)	66 (11)	53 (10)
40-49	61 (21)	70 (14)	31 (13)	35 (12)	69 (15)	50 (17)
50-59	61 (15)	60 (14)	26 (9)	29 (8)	52 (13)	49 (15)
60-69	59 (13)	59 (13)	24 (10)	29 (10)	52 (11)	47 (15)
70-79	58 (7)	55 (10)	23 (8)	27 (8)	53 (12)	48 (11)
>80	52 (14)	52 (10)	19 (7)	20 (10)	45 (9)	37 (21)

- Lateral flexion away significantly related:
  - Age, number of levels dissected, and radiation therapy
- Flexion, rotation towards and lateral flexion towards related:
  - Age
- No significant relationship was found between sacrificing the SCM and reduced ROM, although rotation away from the surgical side was an average of 10 less in patients with SCM sacrificed

Neck Fibrosis

verse

Neck Hypertonicity

Dropped Head Syndrome

- Late effect of HNC medical management
  - *Rare, underreported in the literature*
- Caused by cervical extensor weakness (primary muscle damage or anterior horn or nerve root pathology within radiation field), radiation fibrosis, dystonia
- Results in
  - *Neck & upper back pain*
  - *Impaired breathing, swallowing*
  - *Impaired cancer surveillance*
  - *Impaired stoma care*
  - *Impaired lymphatic drainage*
  - *Decreased quality of life*

[Stubblefield MD. Radiation fibrosis syndrome: neuromuscular and musculoskeletal complications in cancer survivors. PM R. 2011;3:1041-54.]

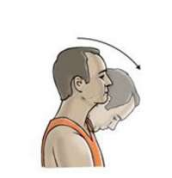
Management of Dropped Head Syndrome

- Postural re-education
- Therapeutic exercise
  - *Anterior neck soft tissue stretches*
  - *Available cervical extensor strengthening*
- Manual techniques
  - *Manual stretching*
  - *Soft tissue mobilization*

Dropped Head Syndrome – Bracing

[Stubblefield MD. Radiation fibrosis syndrome: neuromuscular and musculoskeletal complications in cancer survivors. PM R. 2011;3:1041-54.]

When I look down, I feel an electric shock sensation down my back, arms, and legs



- What is wrong with me?

Examination

- Range of motion
- Sensation
- Palpation
- Postural alignment
- Muscle performance
- Scar Assessment

Scar Assessment

THE PATIENT AND OBSERVER SCAR ASSESSMENT SCALE: Observer Scale	
Vascularity	Presence of vessels in scar tissue assessed by the amount of redness, tested by the amount of blood return after blanching with a piece of Plexiglas [pale, pink, red, purple. mix]
Pigmentation	Brownish coloration of the scar by pigment (melanin); apply Plexiglas to the skin with moderate pressure to eliminate the effect of vascularity [hypo, hyper, mix]
Thickness	Average distance between the subcuticular-dermal border and the epidermal surface of the scar [thicker, thinner]
Relief	The extent to which surface irregularities are present (preferably compared with adjacent normal skin) [more, less, mix]
Pliability	Suppleness of the scar tested by wrinkling the scar between the thumb and index finger [supple, stiff, mix]
Surface area	Surface area of the scar in relation to the original wound area [expansion, contraction, mix]

http://www.posas.org/

Scar Prevention and Management

- Patient education
  - *Avoid prolong sun exposure*
  - *Use sunscreen > 50 SPF*
- Scar massage
- Silicone sheets and silicone gel
- Pressure garments
- Taping
  - *Kinesiotape*

[Arno et al. 2014. Up-to-date approach to manage keloids and hypertrophic scars: A useful guide. *Burns*, 40, 1255-1266.]

[Monstrey et al. 2014. Updated Scar Management Practical Guidelines: Non-invasive and invasive. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 67, 1017-1025.]

[Perez and Rohrich. 2017. Optimizing Postsurgical Scars: A systematic review on best practices in preventative scar management. *Plastic and Reconstructive Surgery*. 140(6): 782e-793e.]

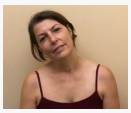
Management of the Neck and Radiation

Radiation: acute, early delayed (>3 months), late delayed (<3 months)

- Prior to treatment:
  - *Maximize ROM*
  - *Manage surgical adhesions*
- During treatment:
  - *Maintain ROM*
  - *Stretching*
- Following treatment:
  - *Soft tissue fibrosis continues to develop post treatment for months to years*
    - Soft tissue mobilization
    - Regular stretching

[Stubblefield MD. Radiation fibrosis syndrome: neuromuscular and musculoskeletal complications in cancer survivors. PM R. 2011;3:1041-54.]

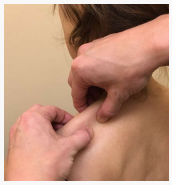
Management of the Neck: Pain Modulation

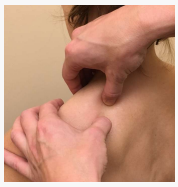
- Manual therapy 
- Taping 
- Therapeutic Exercise 

Pressure Release Technique

Pressure is progressively increased until tissue resistance (barrier) is perceived by the therapist. Pressure is maintained until the therapist senses a relief of the taut band. At that time, the pressure is increased again until the therapist feels the next increase in tissue resistance. Repeated 3 times per session.

Manual Stretching of Taut Bands





Both thumbs of the therapist are placed over the trigger point above and below. The therapist applies moderate, slow pressure over trigger point, sliding the thumbs in opposite directions.

Kinesiotaping

Upper Trapezius: Method 1

Upper Trapezius: Method 2

Kinesiotaping

Levator Scapulae

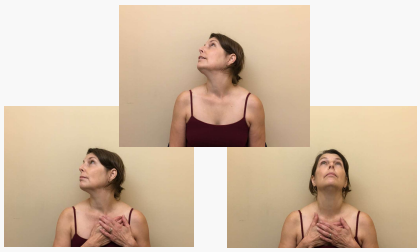
Rhomboid

Therapeutic Exercise

- Cervical Active ROM and Stretching
  - *Scalenes*
  - *SCM*
  - *Upper trapezius*
  - *Levator scapula*
  - *Pectoralis major and minor*
- Postural re-education
- Strengthening

ROM/Stretching

ROM/Stretching



Exercise Prescription

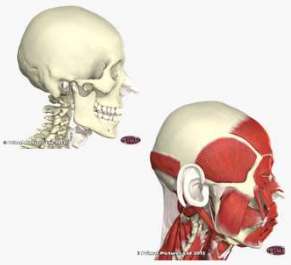
- Strengthening:
  - *Neck Extensors*
    - Cervical and thoracic paraspinal muscles
  - *Scapulothoracic muscles*
  - *Deep Cervical Flexors*
    - Longus capitis & colli

[Jull GA et al. The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain. Man Ther. 2009 Dec;14(6):696-701.]
[Jull GA et al.. Clinical assessment of the deep cervical flexor muscles: the craniocervical flexion test. J Manipulative Physiol Ther. 2008 Sep;31(7):525-33.]
[Amiri Arimi S et al. The Effect of Different Exercise Programs on Size and Function of Deep Cervical Flexor Muscles in Patients With Chronic Nonspecific Neck Pain: A Systematic Review of Randomized Controlled Trials. Am J Phys Med Rehabil. 2017;96:582-588.]

TEMPOROMANDIBULAR DYSFUNCTION

Temporomandibular Disorders

- Muscle disorders
  - *Myalgia*
  - *Myofascial pain*
- Headache
- Joint disorders
  - *Arthralgia*
  - *Osteoarthritis*
  - *Disc disorders*
  - *Hypermobility*
  - *Hypomobility*



[Schiffman E et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group. J Oral Facial Pain Headache. 2014 Winter;28(1):6-27.]

HNC and TMJ Dysfunction

- Trismus
  - *Definition*
    - Impaired mouth opening of 35 mm or less
    - Prevalence: 5-86%
  - *Causes*
    - Surgery
    - Radiation
      - *Involving masseter, pterygoid muscles and temporomandibular joint*

[Buglione, 2016; Stubblefield, 2011; Pauli, 2013]

Trismus

- Consequences
  - *Speech*
  - *Nutritional intake, hydration*
  - *Use of dentures*
  - *Oral hygiene*
  - *Dental treatment*
  - *Cancer surveillance*
  - *Decreased QOL*

[Melchers, 2009; Stubblefield, 2011; Pauli, 2013]

Clinical Examination

International Network for Orofacial Pain and Related Disorders Methodology

A Consortium Focused on Clinical Translation Research

Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) Clinical Examination Protocol Version: January 6, 2014

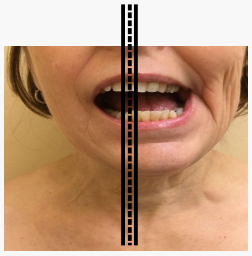
https://ubwp.buffalo.edu/rdc-tmdinternational/tmd-assessmentdiagnosis/dc-tmd/

Mandibular Range of Motion

Opening	Lateral Deviation	Protrusion
Normal: 50 mm	Normal: 8-12 mm	Normal: 4-8 mm

Opening Pattern

- Straight
- Deviation: ≥2mm
  - *Corrected*
    - S-curve
    - C-curve
  - *Uncorrected*
    - Lateral deviation

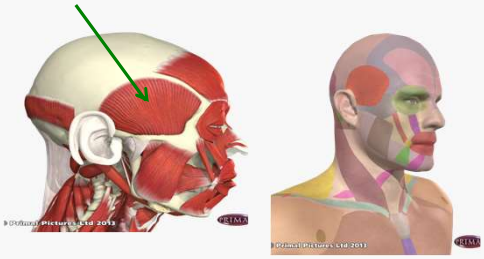


Muscle Palpation

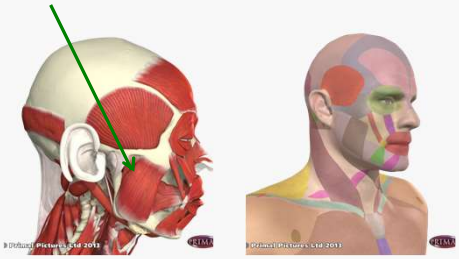
- External
  - *Temporalis*
  - *Masseter*
  - *Medial Pterygoid*
  - *Posterior belly of digastric*
- Intraoral
  - *Tendon of Temporalis*
  - *Lateral Pterygoid*

- Instructions
  - *Apply pressure for 5 seconds (or 2 seconds)*
  - *Pain?*
    - Familiar
      - *Pain "similar" to that patient experiences*
    - Referred
    - Headache

Temporalis



Masseter

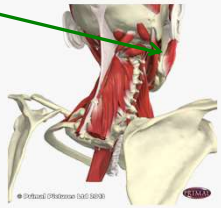


Submandibular region: Medial Pterygoid

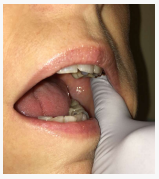
- Area 2cm anterior to the angle of the mandible, and medial to the mandible

Posterior Mandibular Region: Posterior Belly of Digastric

- Area between the insertion of the SCM and the posterior border of the mandible



Tendon of Temporalis



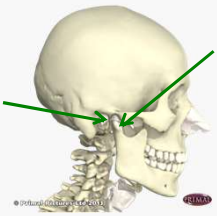
Finger is placed against ascending ramus while mandible is slightly open, and the finger is moved superiorly as far as possible while maintaining contact with underlying hard surface

Lateral Ptyergoid

Finger on buccal side of alveolar ridge above maxillary molars. Have patient shift jaw to same side and move finger distally, superiorly, and medially.

Joint Palpation

Posterior Attachment: External auditory meatus



Lateral Pole: Index finger anterior to tragus of the ear and over TMJ

Joint Noise

- Reproducible click
  - *Opening*
  - *Closing*
  - *Reciprocal*
- Crepitus

Subjective Complaints (Gothenburg Trismus Questionnaire)

Domain	Items
Jaw-Related Problems	• Fatigue or stiffness in jaw • Aches or pain in face and jaw • Pain moving jaw (opening mouth/chewing) • Problems opening mouth wide or taking a big bite • Pain or soreness in jaw muscles • Problems yawning
Eating Limitations	• Problems eating solid food • Problems putting food in mouth • Problems eating soft food • Problems biting off
Muscular Tension	• Clench teeth • Press with tongue • Noises from jaw

Domain	Items
Facial Pain	• Currently • Worst • On average
Facial Pain Impact	• Interfered with social, leisure and family activities • Affected ability to work
Jaw Limitation	• Limitation in ability to open mouth
Jaw Limitation impact	• Interfered with social, leisure and family activities • Affected ability to work

[Johnson, J. Oral Oncol. 2012 August ; 48(8): 730–736.]

Association between maximal mandibular opening and self-report of function

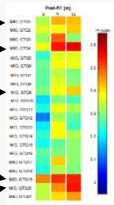
Fatigue/stiffness in jaw?

Problems when opening your mouth wide or taking a big bite?

Problems putting food in mouth?

How much has your limitation to open your mouth interfered with your social, leisure and family activities during the last month?

How limited are you in your ability to open your mouth right now?



Thor M et al. Temporal patterns of patient-reported trismus and associated mouth-opening distances in radiotherapy for head and neck cancer: A prospective cohort study. Clin Otolaryngol. 2018 Feb;43(1):22-30.

Management of Trismus

Muscle problem

or

Articular problem

or

Both???

Management of Trismus

- Jaw Exercises
  - *Self-assisted range of motion*
    - 7 sec - 7 reps - 7 x/day
    - 30 sec – 5 reps – 5 x/day
  - *Active range of motion*
  - *Manual resistive exercises*
  - *Low load, prolonged duration stretching*
- Postural Re-education
- Neck Exercises
- Manual Therapy

[Guru, 2012; Nagaraja, 2016; Buglione, 2016]

Jaw-Opening Devices

- TheraBite Jaw Motion Rehabilitation System
- Orastretch
- Dynasplint Trismus System



Scherpenhuizen A et al. The effect of exercise therapy in head and neck cancer patients in the treatment of radiotherapy-induced trismus: A systematic review. Oral Oncol. 2015;51:745-50.]

Jaw Opening Devices - Evidence

- TheraBite® Jaw Motion Rehabilitation System™ (TheraBite) increased mouth opening between 0 mm and 13.6 mm

- 30 seconds x 5 repetitions, 5 times per day

- Dynasplint® Trismus System (DTS) increased mouth opening between the 6.2 and 13.6 mm

- 30 minutes, 3 times per day
- Gradual increase in force

[Buchbinder, 1993; Cohen, 2005; Shulman, 2008; Baranano, 2011]

What if my patient can't afford a jaw opening device?

Be careful

Not all jaw pain after HNC treatment is due to trismus?

- First bite syndrome
  - *Direct injury to cervical sympathetic trunk or postganglionic sympathetic efferents of the cervical sympathetic trunk*
  - *Imbalance between parasympathetic and sympathetic innervation of parotid gland*
    - Results in a intense contractile response at the first bite, inducing the head and neck pain
  - *Findings*
    - Pain in mouth or TMJ region triggered by salivation or when taking the first few bites of food during a meal.
    - Pain described as intense, sharp or like a muscle cramp
    - Pain lessens with each bite of food but can return if there is a break in eating.
    - Normal physical examination
  - *Treatment*
    - Medications
    - Botulinum Toxin Injection
    - Behavior modification
      - *Avoid eating acidic and sour foods, which can stimulate more saliva production*
      - *Try chewing food on opposite side if pain is unilateral*
      - *Distraction: rubbing face, clenching fists*

Not all jaw pain after HNC treatment is due to trismus?

- Osteonecrosis of the jaw
  - *Tooth or jaw pain*
    - Numbness or feeling of heavy jaw
  - *Mucosal swelling*
  - *Erythema*
  - *Tooth mobility*
  - *Area of exposed bone*
- Cancer recurrence