Prevalence and Clinical Characteristics of Chronic Post-surgical and Post-traumatic Pain in a Tertiary Level Oral Medicine Clinic

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Abstract

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Background: Chronic post-surgical and post-traumatic pain (CP-PTP) occurs after surgery or trauma, persisting beyond the healing time, and is localized to the event or dermatome, while other causes should be excluded. The condition appears to be underdiagnosed and undertreated, with little known about its prevalence and characteristics in the head and neck region.

Aim: The aim of this study was to determine the proportion, clinical characteristics, events and comorbidities of subjects that fit the ICD-11 CP-PTP criteria in a tertiary level oral medicine clinical service.

Methods: A cross sectional study retrospectively reviewing electronic health record charts in the Oral Medicine Clinical Service at the University of Washington was completed between December 1st, 2021 and November 30th, 2022. CP-PTP ICD-11 criteria were applied to all charts that had a pain diagnosis based on ICD-10 billing data. Clinical information was obtained

from the Axium electronic health record and scanned documents including a pain questionnaire completed by all new subjects, a pain drawing, Pain, Enjoyment of Life and General Activity (PEG) measure, Graded Chronic Pain Scale (GCPS), the Symptom checklist-90 revised (SCL-90R), and other measures. Descriptive statistics were used to summarize the findings of each variable collected.

Results: The CP-PTP prevalence was 16.8% (n=89), occurring after surgery in 71% (n=63), following trauma in 14.6% (n=13), and in 14.6% after concurrent trauma and surgery. The median time subjects were followed in the clinic was 14 months (range 0-210 months). The median age was 60.5 years old and three quarters were female. Pain was present for a median of 60 months (5-years) and individuals saw a median of 9.5 providers for their pain condition prior to presenting to the oral medicine specialty clinic. The most frequent event locations were teeth (70.7%), maxilla/zygoma (11.2%) and temporal-parietal areas. The most prevalent CP-PTP subcategories were following amputation (i.e. root canal therapy and dental extraction), peripheral nerve injury and whiplash (71.9%, 24.9%, 19.1%) respectively. The most common craniofacial diagnoses were myofascial pain and possible posttraumatic trigeminal neuropathic pain in 75.2% (n=67) and 64% (n=57) of the cases, respectfully. At the time of presentation to the clinic, 19.1% (n=17) of individuals had pain localized to the area of the event, 16.8% (n=15) in the head and neck and 56.1% (n=50) had pain in at least one location beyond the head/neck region. Moderate or severe anxiety were present in 30% (n=27) and moderate or severe depression in 47.1% (n=42) of the cases. The pain intensity and impact were 4.45 out of 10, measured with the (PEG) mean score.

Conclusions: The prevalence of CP-PTP in the clinical sample was 17%, showing it is a common occurrence in a tertiary care clinic. CP-PTP occurring in the craniofacial region

appears to be under-recognized and undertreated with individuals experiencing pain for a long delay before referral to a specialty oral medicine clinic, resulting in subsequent delays and significant suffering before proper treatment was initiated. The most common event was surgery, however, a significant portion of individuals had myofascial pain as well as possible trigeminal neuropathic pain, emphasizing the need to assess for these comorbid conditions in individuals after surgery or trauma. This is the first study to apply the ICD-11 criteria for CP-PTP in a sample of individuals with craniofacial pain in a tertiary care clinic. The use of the ICD-11 criteria for CP-PTP is feasible but streamlining the collection of relevant clinical information may help to classify the cases more accurately.

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DEDICATION

To God for the opportunity.

To my husband and my parents for always being there and driving me with infinite love.

To my sons, this is for you.

CHAPTER 1.- BACKGROUND

1.- Introduction

Surgery and trauma are common and can result in the development of chronic pain. The International Association for the Study of Pain (IASP) and the World Health Organization (WHO) created a new classification system for chronic pain in the International Classification of Diseases 11th edition (ICD-11). [1] In order to better understand chronic pain that develops after trauma and surgery, the ICD-11 included a classification category "chronic post-surgical and post-traumatic pain" (CP-PTP). CP-PTP is further subdivided by the type of surgery or trauma (Figure 1). The ICD-11 defines chronic pain as persistent, passing the normal healing time and lasting or recurring for longer than 3 months; distinguishing chronic primary pain from chronic secondary pain syndromes (symptoms of another non-pain problem).

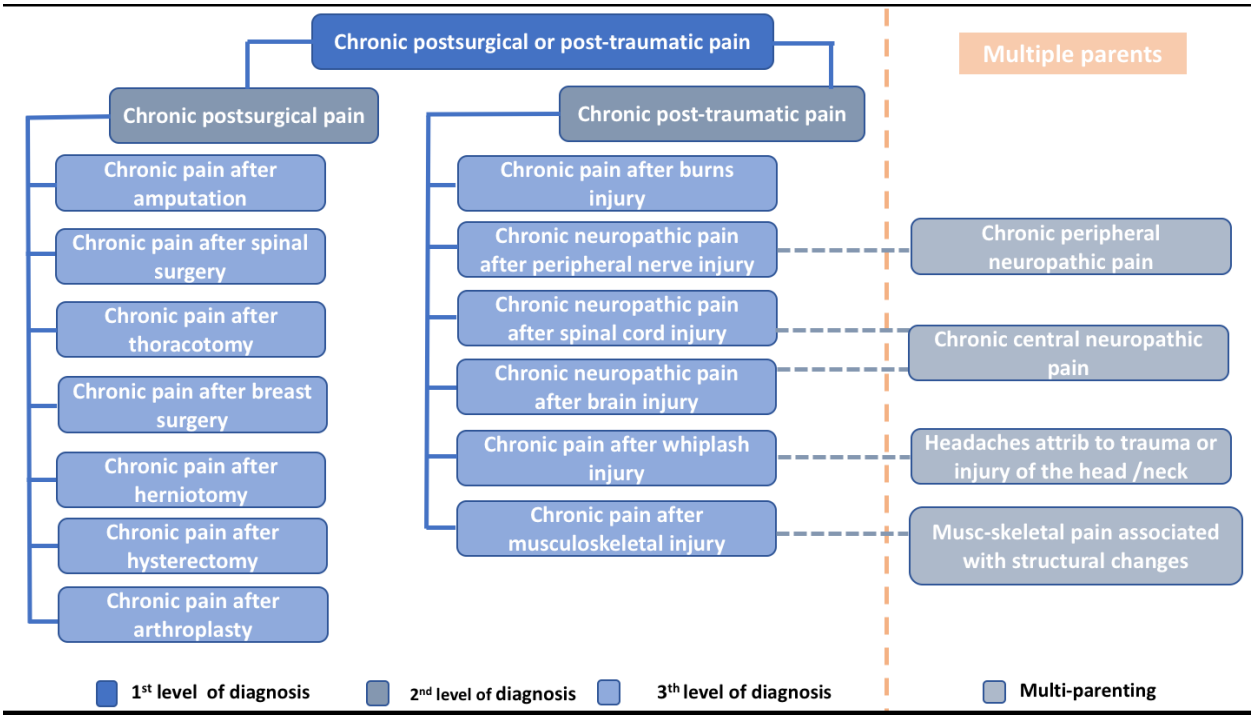

Figure 1.- CP-PTP subtypes and multiple parenting
(Adapted from Schuga et al., 2019)

Surgery has long been recognized as a risk factor for the development of chronic pain but it was first systematically studied by Crombie et al., in 1998 when they identified chronic pain developing in 22.5% of individuals after surgery and 18.7% after trauma at pain clinics in North Britain. [2] Since then, a growing interest in understanding CP-PTP evolved, focused on the importance of identifying individuals with the condition, and developing methods to prevent and treat the condition. [3]

The original definition of chronic pain after surgery and trauma was proposed by Macrae and was refined in 2014 by Werner and Kongsgaard. [4-6] The newest definition by ICD-11 defines CP-PTP as *"pain that develops or increases in intensity after a surgical procedure or tissue injury and persists beyond the healing process, at least 3 months after the initiating event. The distribution of pain must be localized to the area of the surgery or trauma and projected to the innervation territory of the nerves affected or a referred dermatome. Other causes of pain from a separate primary cause should be excluded¨* (e.g., cancer, chronic infection, loose hardware, etc). [1] Additionally, it is important to note that some surgeries are performed for pain as an indication, therefore, CP-PTP includes pain that developed or increased in intensity after any surgical procedure. [1] The new ICD-11 classification system allows for "multiple parents" such that a peripheral neuropathic pain that develops after surgery can be classified as both CP-PTP and "chronic peripheral neuropathic pain" (figure 1). Defining CP-PTP under the new ICD-11 and allowing for multiple parenting will allow researchers to better understand these conditions and clinicians to recognize them.

1.2 Mechanism

CP-PTP does not imply a pain mechanism, but rather captures any chronic pain that develops or increases after trauma or surgery. One way to classify pain mechanisms is "neuropathic," "nociceptive," and/or ¨nociplastic,¨ and some pains may have features of multiple mechanisms. Neuropathic pain requires a demonstrable lesion or disease of the somatosensory system, while nociceptive pain arises from damage to non-neural tissue and is due to the activation of nociceptors.[7] ¨Nociplastic¨ pain was established by Koseka et al., and it inferred that altered nociceptive function does occur in subjects experiencing pain, unassociated with frank signs of neuropathy, but is characterized by hypersensitivity in apparently normal tissues. The term "nociplastic" is derived from "nociceptive plasticity," and describes changes in the function of the nociceptive pathways. The ¨plastic¨ term describes the phenomenon of hypersensitivity occurring in normal tissues in which sensitization may be the underlying mechanism. "Nociplastic pain" is hypothesized to occur after the interaction of multiple risk factors, including physical or chemical signaling from trauma/surgery, combined with a history of psycho-social distress.[8] Determining the pain mechanisms involved is important for implementing therapies. For example, individuals with nociplastic mechanisms will typically respond better to centrally rather than peripherally targeted therapies.[7,8]

To explain why CP-PTP occurs, scientific research with animal models has demonstrated pain sensitization from persistent noxious signaling, and changes to the inhibitory modulation in the medullary-spinal and descending pathways.[9] Maladaptive neuroplastic changes occur because of neurotrophic factors, neurons, and microglial interactions. In this setting, the microglial intracellular signals will be upregulated and activated, resulting in continual neural stimulation, leading to chronic pain perception.

1.3 Risk factors for the development of CP-PTP

The onset of CP-PTP follows trauma or surgery. Persisting pain following trauma/surgery has been associated with biological, psychological, and social factors that influence the pain modulation pathway. [6,9,9] These risk factors for developing CP-PTP are not independent of each other, but instead are interlinked. Different reports have focused on surgical risk factor interactions, however they are not specific to traumatic cases, although it is possible that surgical risk factor information can be extrapolated to chronic pain after trauma.

A six-clinical-factor model identifies subjects at risk of CP-PTP and includes type of surgery, age, physical and mental health, preoperative pain in the surgical field and in another body area. [9] Another model classifies the risk factors according to the preoperative, intraoperative, and postoperative periods, and covers six broad domains: genetic, demographic, psychosocial, pain characteristics, clinical, and surgical factors, described according to Schuga and Richebe. [6,10] (table 1)

Table 1.- CP-PTP risk factors
(Predictor factor ranking: * * *: high, * *: moderate, *: mild association)

	Pre-event	Intraoperative	Post-event
Demographics	* * Female * Younger ages		
Pain history	* * * Chronic pre-operative, pre-trauma pain * * * Moderate-severe intensity	* * General anesthesia without local infiltration * * Deficient or absent intraoperative analgesic reinforcement	* * * Acute secondary hyperalgesia * * * Moderate-to-severe intensity (Every 10% of increased time in severe postoperative pain is associated with a 30% increase in chronic pain at 12 months after surgery * * Poor postoperative analgesia
	* * Multiple surgeries	* * * Prolonged surgery time	

Medical history	* Genetic alterations (inefficient noxious inhibitory control-encoding ion channels and purinergic receptors). Mutations of genes encoding catechol-O-methyltransferase (COMT), related to changes and exacerbation of pain sensitivity. The *OPRM1* gene encoding the m-opioid receptor. *GCH1*, *CACNG*, *CHRNA6*, and *P2X7R* which are cytokine-associated * Smoking	* * * Invasive or traumatic surgery Both are associated with inflammation and nerve compression.	
Psychosocial	* * Psychological vulnerability (Anxiety, neuroticism, depression fear of the procedure, pain expectation pain catastrophizing, low optimism about the procedure, somatization hypochondriasis)	* * Psychological vulnerability	* * Psychological vulnerability
Other	* *Exaggerated responses to quantitative sensory testing (QST)		* *Exaggerated responses to quantitative sensory testing (QST)

Moreover, surgical complications and multiple dental procedures such as root canal therapy (RCT), extractions, dental implants have been risk factors for the development of pain in dentistry. [11] These procedures may involve repeated injuries to the tissues that can sensitize the peripheral and central nerve pathways. This explains why repeated procedures in the same region can be the origin of chronic pain. However, in cases in which the pain is the reason for the intervention, the procedure could exacerbate or increase the preexistent pain, making future treatments less effective. [12]

1.4.- Clinical characteristics and diagnosis of CP-PTP

CP-PTP has been reported to continue after an event (surgery or trauma) for a median of 14.6 to 26.3 months. [9,13] There is no criteria defining how long after an event the condition may begin to be considered CP-PTP. Some clinical characteristics have been summarized in table 2. [6,14-16] The risk factors for developing the condition include the type of surgery, preexisting pain, multiple interventions, nerve damage, high pain intensity and psychosocial factors. A multifactorial etiology is thought to be associated with the inflammatory response that leads to peripheral and central sensitization. [17] In dentistry, some individuals have a history of multiple treatments aimed at eliminating their pain complaint. Therefore, it is important to collect a detailed history of the initiating event and pain timeline.

Clinical and psychosocial factors have been associated with pain chronicity, prognosis and treatment outcomes. [18] As part of the diagnosis and response to treatment monitoring it is important to map the pain location, obtain an accurate pain and event history, and screen for psychosocial distress. Also, the administration of local anesthetics (LA) can be used as a diagnostic tool to identify the site and source of pain. [19]

Table 2.- CP-PTP clinical characteristics

DOMAIN	CP-PTP CLINICAL CHARACTERISTICS
Location	Same dermatome of the event. Projected pains could be noted.
Intensity	Moderate-to-severe (Visual analog scale ranging from 4 to 10)
Quality	Aching, burning, shooting, throbbing, and stabbing
Frequency	Persistent, continuous, and daily for years. Rarely reports of pain-free or remission periods
Triggers and somatosensory features	May be spontaneous or evoked by sensory stimuli like light touch representing hyperalgesia or allodynia, suggesting changes in central somatosensory processing No latency or refractory period as in trigeminal neuralgia

Comorbidities	May coexist with other chronic orofacial pain or headache conditions. (i.e., paresthesia, numbness, and burning sensation)
Associated sensations	Swelling, foreign body, hot or cold, local redness or flushing
Other pain descriptors	Can be deep or superficial; excruciating and spreading. Diffuse, poorly localized Unilateral, and with few bilateral cases (9%)

1.5.- Incidence and prevalence

Approximately 312 million people worldwide and more than 100 million in the USA and Europe undergo surgical procedures each year, and this number is increasing over time. From a cross-sectional survey performed on 12,982 subjects, 2,043 recalled having had any kind of surgery more than 3 months before the study, and persistent pain was reported in 40.4%.[20] Other estimates have been lower, such as a cross sectional study in Norway found the prevalence of pain >3 months after a surgical procedure to be closer to 18%.[20] And Crombie et al., found the prevalence of post-surgical pain to be 22% of patients presenting to pain clinics across northern Britain. [2] Other estimates report that CP-PTP can affect an average of 10% of people one year after major surgery and can be intolerable in 1% of them. [6]

Between 3% to 85% of the subjects are affected with CP-PTP depending on the type and area of surgery. [9] The incidence ranges from 30-85% after extremity amputation, 5-65% after thoracotomy, 5-63% after inguinal hernia surgery, 3-50% after cholecystectomy, 10-57% after mastectomy, 0-37% after vasectomy, and 6-55% after cesarean. Otherwise some craniotomies have been associated with chronic post-surgical pains in 7 to 30% of cases. [1] Distinct parts of the body are susceptible to developing CP-PTP at different rates, [1] but the reasons for these discrepancies are not clear and case selection, study design, and differences in surgical techniques among the factors influencing the ranges reported.

After oral and maxillofacial surgery, the CP-PTP incidence has been estimated between 5 to 13%.[9] Ten million teeth are extracted from 5 million people in the USA yearly, and chronic pain has been reported to persist in 13% of the population. [21] While the exact prevalence of dental implant surgeries per year has not been determined, some estimate that by 2026, 23% percent of the population may select implants as a treatment option [22] and it is hypothesized that 8-13% of individuals are at risk for developing chronic pain after implant surgery. [23-27] Regarding dental surgeries, third molar surgery is the most frequent cause of trigeminal nerve injury (48%), followed by dental implants (13%).[23,24,26] An increase in dental implant procedures and third molar extractions could be associated with more subjects experiencing CP-PTP, but additional studies are needed to quantify this possibility. In orthognathic surgery (OS), the reported incidence of neuropathic pain in the literature after mandibular osteotomies is less than 1%.[28,29] By 2016 more than 15 million RCTs were completed by year in the US, and it is estimated that between 3% to13% of their population experience chronic pain after RCTs. [23-27] Five to 10% percent of individuals who receive initial root canal treatments (RCT) experience pain for 6 months following treatment. [30] These results are lower than the CP-PTP incidences observed after other procedures performed outside the neurosensory distribution of the trigeminal nerve. However, there is a lack of understanding if the reason was an undiagnosed incidence of CP-PTP after craniofacial interventions or if the subjects have intrinsically less risk to develop it. Hence, further studies should be conducted.

In summary, CP-PTP seems to be less common in the craniofacial area and the exact reason for this has not been determined. Benoliel et al. attributes this to a relative resistance of the trigeminal nerve to trauma-induced hyperactivity because the trigeminal nerve displays significantly less ectopic discharge than other peripheral nerves, but also should be considered that that many people

develop paresthesia of the trigeminal nerve branches following trauma, which would also lead to less pain. This may explain the low incidence of pain in the trigeminal system

Also, it could be related to the common use of LA during almost all facial and dental procedures to control perioperative pain and may help prevent the development of chronic pain. [31,32]

1.6.- Justification and purpose of the study

Globally, more than 320 million people have surgery each year, which represents a vast potential for developing CP-PTP, and creating a likely burden for healthcare systems worldwide. Thus, it could be hypothesized that CP-PTP is an under-recognized complication from craniofacial and dental surgeries. Because CP-PTP is a distressing chronic pain condition resulting from surgical and traumatic events with long term consequences such as poor response to treatments, the health care implications should not be underestimated. [33]

Since the CP-PTP concepts is just being introduced and might not be taught in dental schools, many dentists and other healthcare professionals could be unaware of it, also it is difficult for subjects to communicate the unfamiliar symptom qualities, leading to delays in diagnosis and unnecessary surgical treatments, which could worsen the prognosis. Therefore, its early identification can prevent further deterioration of the condition, especially if some risk factors are modifiable.

Annually, 15.1 million people in the US receive root canal treatments (RCTs) and 10% of them report chronic pain after those RCTs. [34] When CP-PTP is not recognized in these cases, individuals may have unnecessary appointments, tests, and treatments. Almost half (41.9%) of those that have chronic pain after RCTs (5%) experience more or equal pain after the secondary RCTs, compared to those that do not receive additional RCTs. [30]

A pragmatic approach to these challenges has been the development of transitional pain clinics, with the aim to overcome the disconnection between acute and chronic pain management, identifying the risk for chronic pain through patient screening. [35] Follow-up visits of at-risk subjects after surgical or posttraumatic visits could allow prompt diagnosis and treatment of CP-PTP.

Identifying cases of CP-PTP in a specialty oral medicine practice, which cares for a larger proportion of chronic pain subjects is important to reduce disease morbidity and to counteract the indirect and direct healthcare costs incurred in subjects experiencing CP-PTP. Reported costs per subject were estimated in follow-ups totaling $2000 or more. [33]

To our knowledge, this is the first study to apply the ICD-11 diagnostic criteria to estimate the CP-PTP prevalence in the craniofacial region, among a cohort of pain subjects presenting to a specialty oral medicine clinic (UW School of Dentistry Oral Medicine Clinical Services – UWOMCS).

1.7- Specific Aims

1.- Determine the proportion of subjects that fit the CP-PTP ICD-11 classification criteria within the pain subjects presenting to an oral medicine clinic at the University of Washington over a one-year time period.

2.- Describe the demographic, clinical, and psychosocial factors of subjects who meet the CP-PTP criteria.

3.- Identify and describe the event (trauma or surgery) that led up to the development of CP-PTP.

4.- Identify other pain conditions and comorbidities that co-occur in individuals classified with CP-PTP in the sample studied.

5.- Assess the feasibility of applying the ICD-11 CP-PTP diagnostic criteria to a sample of subjects presenting to an oral medicine clinic.

CHAPTER 2. MATERIALS AND METHODS

2.1.- PARTICIPANTS

A list of all subjects seen for at least one visit with a pain diagnosis based on ICD-10 codes (Appendix 1) between December 1st 2021, and November 30th 2022 was obtained.

2.2.- Setting

The Department of Oral Medicine at the University of Washington School of Dentistry is an ideal site for collecting data on chronic craniofacial pain since it is an orofacial pain referral center, with approximately 89.9% of visits listing pain as a chief concern each year. [36] At the time of this study there were seven board eligible oral medicine specialists practicing in the clinic whose patient records were available for review.

2.3.- Inclusion and exclusion criteria

. -Inclusion criteria.

1.-Males and females

2.-Adults 18 years or older

3.-CP-PTP diagnostic criteria according to ICD-11

3.1.-Craniofacial pain as the primary or secondary chief complaint

3.2.- Pain that develops or increases in intensity after a surgical procedure and/or traumatic event in the craniofacial area.

3.3.- Persistent pain in the craniofacial area for at least 3 months or more after the initiating event

3.4.- Pain without any tumoral, autoimmune, nutritional, or infective cause that can explain the pain.

3.5.- Pain localized in the surgical field or area of injury or projected to the innervation territory of the nerve situated in this event area.

. -Exclusion criteria.

- Younger than 18 years old
- With specific clinical, pathological, or radiological findings that explain a different pain diagnosis from CP-PTP.
- Did not have sufficient information in the electronic health record to determine if criteria for CP-PTP diagnosis is met.

2.4.- Study Design

This study is a cross-sectional study of electronic health record data from subjects presenting to the University of Washington School Of Dentistry – Oral Medicine Clinical Services (OMCS) between December 1st 2021 and November 30th 2022. The study was approved by the University of Washington Institutional Review Board (IRB#: STUDY00016197).

2.5.- Statistical Analysis

No power and sample calculations were conducted since this is a descriptive study. To analyze the continuous data, a descriptive statistic was presented as mean and median with ranges, while categorical data were reported as absolute numbers with percentages.

2.6.- Data collection

A screening form (table 3) using the inclusion criteria was created using REDCap (Research Electronic Data Capture) electronic data capture tool hosted at the University of Washington, which is a secure, web-based software platform designed to support data capture for research studies. Redcap at ITHS is supported by the National Center for Advancing Translational Sciences of the National Institutes of Health under Award Number UL1 TR002319. [37,38] Each chart was accessed using the Axium electronic health record (Henry Schein Axium Dental Software. Accessed 16 January 2021. https://www.exansoftware.com/axium). The screening form was piloted by clinicians and reviewed by the study team. The screening for CP-PTP was performed by the P.I .(J.V), and a second investigator (M. C) double-screened 50% of the cases for accuracy. Cases with unclear information in the chart were discussed with the committee members until an agreement was reached for how to classify cases. Information was obtained from a pain questionnaire administered to all new subjects, clinical notes or attached forms.

Table 3.- Inclusion criteria screening questions

Inclusion criteria	Answer options
Patient ID number	Blank space to be filled manually with a random unique study ID number to be screened
≥18 years old	▪ Yes ▪ No
Was the craniofacial pain the primary or secondary chief concern or diagnosis?	▪ Yes ▪ No ▪ Not enough information to assess
Did the pain develop or increase in intensity in the craniofacial area, after head and/or surgery or trauma?	▪ Yes ▪ No ▪ Not enough information to assess
Is the pain persistent in the craniofacial area for at least 3 months or more after the initiating event?	▪ Yes ▪ No ▪ Not enough information to assess
Clinical or radiographical pathology detected?	▪ Yes ▪ No ▪ Not enough information to assess
Is the pain localized to the surgical field or area of injury, or projected to the innervation territory or dermatome of the nerve situated in this event area?	▪ Yes ▪ No ▪ Not enough information to assess.

Does the case fit with the CP-PTP criteria?	▪ It will be marked as ¨YES¨: only if questions 4, 5, and 7 were ¨Yes¨ and 6 was ¨No¨ ▪ It will be marked as a ¨NO¨ option only if questions 4,5,7 answers ¨No¨ and Q 6 answers ¨Yes¨.

A second REDCap form captured the demographic, clinical and psychosocial characteristics of the cases that fit the CP-PTP criteria (table 4). The form captured detailed information about: a) The pain history prior to the OMCS visit, b) the clinical characteristics of the precipitating event, c) the comorbidities present in the sample and d) the qualitative pain findings in order to match the findings with the previous CP-PTP clinical features described in the literature and before in this document. The data were entered manually by the PI (J.V.), cases with unclear information in the chart were discussed with the committee members until an agreement was reached for how to enter the data.

CP-PTP subgrouping: Individuals were classified as post-surgical cases if they reported surgery as the inciting event or if pain worsened after surgery. The ICD-11 has seven 3rd level diagnoses for chronic post-surgical pain, only pain "chronic pain after amputation" was used from these suggested levels due to its relevance to the head/neck and oral region (figure 1). Procedures including RCTs, and tooth extractions were classified as ¨chronic pain after amputation.¨ Additional subgroups were created including chronic pain after; dental implants, bone regeneration, restorative dental work (i.e crowns), fracture reduction, temporomandibular joint surgery, orthognathic surgery, aesthetic procedures, and other head and neck surgeries to classify cases. Individuals were classified as post-traumatic cases if they reported trauma (i.e motor vehicle accident, fall, physical trauma from being hit in the craniofacial region etc) as the inciting event for their pain or as a cause for worsening their pain consistent with the ICD-11

definition of CP-PTP. The ICD-11 has six 3rd level diagnoses for chronic post-traumatic pain (figure 1) into which cases were sub grouped.

Pain intensity: The Graded Chronic Pain Scale (GCPS) was used to assess pain intensity, a multidimensional measure that assesses chronic pain severity as well as pain-related disability over a 6-month time period. [39] Pain intensity was assessed at the present time during the first clinical visit, the worst pain in the past six months, and the average pain in the past six months. The GCPS is suitable for use in all chronic pain conditions, including chronic musculoskeletal and lower back pain. All items were scored on an 11-point Likert scale, with responses ranging from 0–10, with higher numbers corresponding to higher pain intensity.

Qualitative sensory testing: Qualitative sensory testing (QualST) is a chairside diagnostic test used to screen for changes in somatosensory function. [40] It examines the qualitative response to light touch, pinprick, hot and cold by comparing the affected side to the normal side. The test has been compared to quantitative sensory testing (QST) and has been found to have 89-94% agreement between the two tests for individuals with no somatosensory changes, and slightly less agreement for classifying cases with somatosensory changes. Only the results for light touch were used, as this is the most consistently completed test in the OMCS clinic for screening purposes. Individuals were grouped into one of the following categories: *normal cranial nerve exam, allodynia* (pain due to a stimulus that does not normally provoke pain, non-unpleasant), *hyperalgesia*, (increased pain from a stimulus that normally provokes pain), *paresthesia*

(abnormal sensation, whether spontaneous or evoked). Information was obtained from the clinical note exam findings or attached qualitative sensory exam forms.

Pain location and extent: The diagnostic criteria for temporomandibular disorders (DC/TMD) pain drawing, served as the anatomical representation of a subjects' pain location(s). [41] This is a self-reported instrument in which individuals mark all their areas of pain. There are 5 views including intraoral, right and left sides of the face, front and back full body views. Areas marked were grouped into discrete locations listed in tables 6 and 7. Any extent of pain within an area was considered to be positive for the corresponding structure listed. For example, pain in the buttocks, thigh, knee, ankle, foot or anywhere else in the lower extremity was classified as pain in the lower extremities. Pain in an elbow, wrist, hand, or any part of the upper extremity was classified as pain in the upper extremity.

Pain extent was defined as local, regional, or widespread based on the locations identified on the pain drawing. "Local" was defined as pain that was limited to the area of the event (i.e surgical event to the teeth and pain in the teeth or nearby soft tissues). Regional was defined as pain in the head and neck, and widespread was pain in the head and neck as well as at least one site outside of the head/neck region.

Medical comorbidities and other pain conditions: The pain questionnaire, a clinical questionnaire created and used in the OMCS clinic for all new patients collected patient self-reported medical conditions. This list was supplemented by information found in the electronic health record clinical notes from the first visit.

Craniofacial pain diagnoses: Appendix 1 shows, the most common craniofacial pain diagnoses used in the OMCS clinic (ICD=10), reported by the providers in the study sample. All the craniofacial diagnoses listed in the clinical note were included even if they were unrelated to the specific CP-PTP event.

Psychosocial factors: Psychosocial factors were assessed using Pain, Enjoyment of Life and General Activity (PEG) and select subscales (anxiety, depression, somatization with and without pain) from the Symptom Checklist 90R. [42,43]

*PEG scale: is a*n ultra-brief three-item scale derived from the Brief Pain Inventory to measure pain intensity and interference and is a reliable and valid measure for chronic pain. [43] The PEG scale measures pain average, interference with enjoyment of life, and interference with general activities in the last 7 days on an 11-point numerical rating scale. An overall PEG score is calculated by taking the average of the individual item scores (range 0-10). Higher scores indicate more severe pain and interference. The measure is used to track individual changes over time. The PEG score is calculated by the average of individual item scores (range 0–10). Individual item scores can also be assessed for the three items. Higher scores correlate with higher pain intensity or interference.

SCL90R: SCL90R is an abbreviated version of the SCL-90, a self-reported and validated psychometric instrument. [42,44] The subscales for anxiety, depression, and somatization with and without pain are administered in the OMCS clinic at the first visit for all pain patients and were assessed in this study.

Feasibility of applying ICD-11 criteria to oral medicine clinical cases: The principal investigator (J.V.) and co-investigator (M.C.) collected descriptive notes when screening cases for the ICD-11 criteria and the challenges they encountered in categorizing cases. These notes were reviewed and themes identified to generate a qualitative review of the challenges encountered.

Table 4. CP-PTP case characteristics form

Demographics	**Answer options**
Date of Birth	Month/day/ year
Sex	• Female • Male
Ethnicity	• American Indian • Asian or Pacific slander • African American • White • Latin • Other • Unknown.
Marital status	• Single • Married • Widowed, • Divorced, • Separated • Never married • Unknown
Employment status	• Employed • Retired • Disability • Unemployed • Student • Indeterminate.
Tobacco use	• Yes, current • Never smoke • Past history • Indeterminate (Smoking, vaping, and chewing will be included as positive answers)
Follow up OMCS period	• First and last visit to OMCS will be collected, follow up time in months will be calculated from these dates
Number of providers visited because the craniofacial pain	• Self-reported number of providers visited by subjects prior to visit in OMCS.
Pain history prior to OMCS visit	**Answer options**
Presence of pain in the same dermatome before the initiating event (trauma or surgery)	▪ Yes ▪ No ▪ Undetermined.
Pain response to the event	▪ Decreased

	▪ Increased, ▪ Same ▪ Unknown.
Pain timeline (The selected option will precede the event followed by the chronic pain)	▪ No history of pain prior to the event (I.e., surgery/trauma) ▪ Positive history of pain in the same dermatome prior to the event ▪ Positive history of pain in a different dermatome prior to the event ▪ Unknown.
Treatments received for pain condition before the OMCS visit	▪ Non-surgical treatment (I,e. reassurance, medications, local therapies, etc.) ▪ Minimally invasive procedures (including injections, arthrocentesis, etc.), ▪ Invasive procedures (I,e. RCT, surgeries) ▪ None, ▪ Unknown
Is the pain located in the same anatomical distribution as the event?	▪ ¨Yes, only limited to the event area¨ ▪ ¨Yes but includes adjacent areas¨ ▪ No, it is in a different, but surrounding area. ▪ Not collected
Duration of CP-PTP	▪ Registered in months
Was the patient treated with opioids for this craniofacial pain?	• Yes • No • Unknown
Clinical characteristics of the event	**Answer options**
Trauma and/or surgery specific events	*The ICD-11 subtype classification of CP-PTP was listed between each subgroup (table 5)* • Trauma • Surgery • Both
Location of the craniofacial event	Obtained from the clinical notes and extrapolated into one of the anatomical areas listed in tables 6 and 7.
Is the pain located in the same anatomical distribution of the event?	• Yes, only limited to the event area • Yes, but include other surrounding areas. • No, it is in a different but surrounding area. • Not collected.
Location of the pain	Pain drawing self-reported by the patient extrapolated into the anatomical areas listed in tables 6 and 7.
Pain Intensity	• At the Present time (first OM visit) • The worst pain in the past six months • The average pain in the past six months *11 point Likert Scale (0 to10)*
Temporal behavior of the pain	• Continuous with minimal variation in intensity • Continuous with increased variation in intensity • Intermittent or episodic • Indeterminate.
Quality of pain	Patient self-report: Numbness, tingling, throbbing, shooting, sickening, sharp, gnawing, cramping, unbearable, burning, tiring, heavy, tender, punishing, aching, exhausting, stabbing, fearful, splitting, cruel, pulling, terrifying, annoying, stinging, hot, cool, none, or another category not mentioned.
Qualitative findings	• Normal cranial nerve exam. • Allodynia • Hyperalgesia • Paresthesia

	• Not clearly detailed
Comorbidities	**Answer options**
Craniofacial comorbidities	• Myofascial orofacial pain • Temporomandibular joint (TMJ) pain • Possible Posttraumatic trigeminal neuropathic pain (PTTNP). Defined as: Chronic Pain in a neuroanatomically plausible area, history of peripheral injury, no diagnostic test confirmation, QST demonstrated allodynia which is not sufficient to demonstrate a lesion with enough certainty but helps in differentiate PTTNP from other conditions. • Orofacial pains resembling presentations of primary headaches (autonomic cephalalgias/cluster headaches) • Burning Mouth Syndrome • Persistent Idiopathic Facial Pain (PIFP). • Persistent idiopathic dentoalveolar pain (PIDP) • Primary headaches (TTHA, migraines, etc.) • Cervical pain • None • Others
Location of pain beyond the craniofacial region	According to the anatomical areas specified in table 6.
Medical comorbidities	• Fibromyalgia • Musculoskeletal pain (beyond craniofacial area) • Heart disease • Thyroid disease • Arthritis • High blood pressure • Cancer • None • Others (Neuropathies, chronic lung disease, stroke, diabetes, chronic kidney disease, obesity, gastric pains)
Location of extra-craniofacial pain	According to the anatomical areas specified in table 7.
Psychosocial characteristics	**Answer options**
PEG-scale	• Pain intensity (0-10) • Pain interference with general activity (0-10) • Pain interference with the enjoyment of life. (0-10)
46 item SCL90R	Contains 46 items evaluated and scored as: Anxiety: • Normal= <0.445 • Moderate= 0.445 to <1.105 • Severe= >1.105. Depression • Normal= <0.535. • Moderate=0.535 to <1.100=moderate • Severe= >1.100. Somatization with pain • Normal=<0.500 • Moderate= 0.500 to <1.000 • Severe= >1.000=severe. Somatization without pain • Normal= <0.428 • Moderate= 0.428 to <0.857 • Severe= >0.857

Table 5.- Trauma and surgery subclassification.

Trauma	Surgery
• CP after burns injury (Chemical / thermal)	• CP after amputation for: • Root canal treatment (RCT)
• CP after peripheral nerve injury / chronic peripheral neuropathic pain (Physical trauma by falls, car accidents, bike accidents, skin lacerations, etc.)	• CP after amputation after: • Dental extraction, or any anatomical part removal of the H/N
• CP after brain injury /Chronic central neuropathic pain (cranial trauma, concussion, etc.)	• CP after dental implant
• CP after whiplash / Headache after to trauma or injury of the head and neck	• CP after bone regeneration,
• CP after musculoskeletal injury (Headache after trauma or injury of the head and neck	• CP after fracture reduction
• Microtrauma (ex, long-term dental treatment, intense occlusal trauma)	• CP after TMJ surgery
• Others.	• CP after orthognathic surgery
	• CP after aesthetic procedures • (Facelift, rhinoplasty)
	• CP after other head and neck surgeries • (Eye surgery, ENT surgeries, etc.)

Table 6.- Location of surgical or traumatic craniofacial event or pain

• Neck	• Upper posterior teeth
• Head (temporal, parietal, occipital)	• Upper anterior teeth
• Nose	• Lower posterior teeth
• Supraorbital / frontal area	• Lower anterior teeth
• Maxilla / Malar area/ Zygomatic	• Intraoral soft tissues
• Mandible	• Nasopharynx, oropharynx
• Submandibular area	• Other

Table 7.- Location of surgical or traumatic event or pain beyond the craniofacial region

• Shoulder (s)	• Abdomen
• Upper extremities	• Lower extremities
• Back	• None
• Chest	

CHAPTER 3. RESULTS

3.1.-Prevalence of CP-PTP

Five hundred thirty consecutive patient charts seen for a pain diagnosis were eligible for screening. Fifty-eight charts (10.9%) had missing inclusion criteria information and could not be classified and thus were excluded, 72% were excluded for not meeting the CP-PTP criteria. Over the one-year period reviewed, the prevalence of CP-PTP presenting to the oral medicine clinic was 16.7% (n=89). CP-PTP occurred after surgery in 71% of subjects (n=63), after trauma in 14.6% (n=13), and in 14.6% (n=13) of individuals after concurrent trauma and surgery (figure 2).

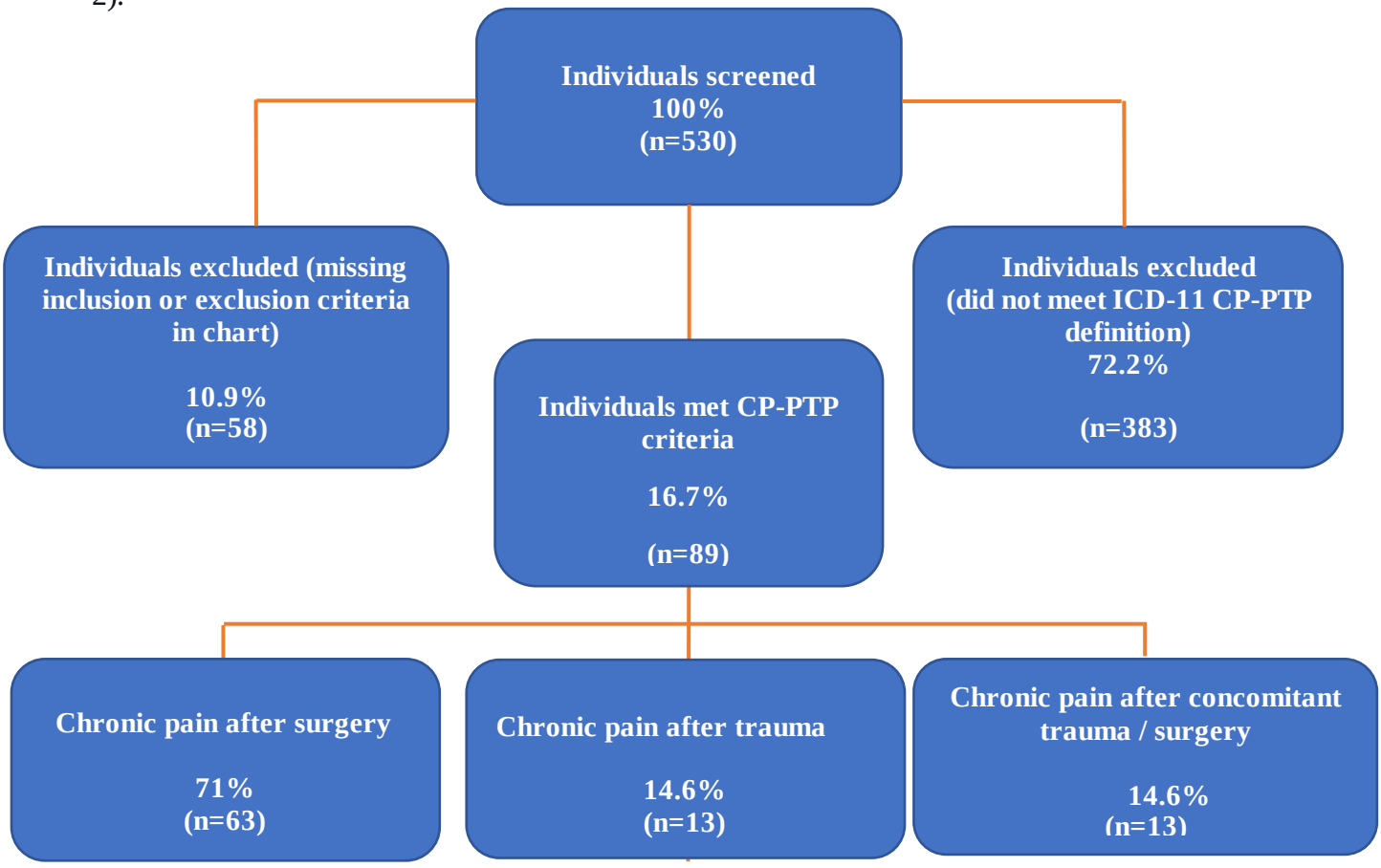

Figure 2.- Screening results and prevalence of CP-PTP

3.2.- Demographic, clinical, and psychosocial factors

3.2.1.- Demographic results

The median age for CP-PTP was 60.5 years, and three-quarters were female. Individuals sought care from multiple providers (median= 9.5) for their pain concerns prior to presenting to the OM clinic. The median length of time followed in the OMCS clinic was 19 months. Additional demographic information is summarized in Table 8.

Table 8.-Demographic characteristics

DEMOGRAPHICS	**CP-PTP (All groups) % (n=89)**	**CP-PTP Post-surgery % (n=63)**	**CP-PTP Post-trauma % (n=13)**	**CP-PTP Concurrent trauma and surgery % (n=13)**
MEDIAN AGE (RANGE)	60 .5 (32-88)	59 (32-88)	65 (36-72)	57 (36.75)
SEX				
FEMALE	77.5% (69)	74.6% (47)	84.6% (11)	84.6% (11)
MALE.	22.4% (20)	25.3% (16)	15.3% (2)	15.3% (2)
ETHNICITY				
WHITE	68.5% (61)	68.2% (43)	61.5% (8)	76.9% (10)
ASIAN OR PACIFIC ISLAND	13.4% (12)	17.4% (11)	7.6% (1)	0 % (0)
OTHER	17.9% (16)	14.2% (9)	30.7% (4)	15.3% (2)
Providers seen Median (Range)	9.5 (1-60)	9.5 (2-60)	7 (1-60)	11 (3-60)
Pain chronicity (months) Median (Range)	60 (6-672)	60 (6-672)	54 (13-360)	36 (24-480)
Months followed in *OMCS* Median (Range)	14 (0-210)	14 (0-210)	9 (0-154)	15 (0-153)

CP-PTP: Chronic post-surgical and post-traumatic pain.
Others: Latin (n=3), American Indian (n=2), Afro- Americans (n=0), not clearly defined (n=11)

3.2.2.- CLINICAL CHARACTERISTICS

The median time between onset of symptoms and presenting to the OMCS clinic was (pain chronicity) was 60 months (table 8). Pain in the same dermatome was present before the inciting event (i.e., surgery or trauma) in 50.6% of cases (n= 45). Prior to presenting to the OMCS clinic 82% (n=73) of the subjects had received non-surgical treatment; and 80.8% (n= 72) received invasive treatment from other providers to mitigate their pain. The post-traumatic CP-PTP sub group showed non-surgical treatment as the most common treatment (92.3%, n=12). Prior pain and treatment history are summarized for each subgroup in table 9.

Table 9.- Prior pain and treatment history

Prior history of pain in dermatome affected by CP-PTP	**CP-PTP All groups % (n=89)**	**CP-PTP Post-surgery % (n=63)**	**CP-PTP Post-trauma % (n=13)**	**CP-PTP Concurrent trauma and surgery % (n=13)**
Yes	50.6% (45)	60.3% (38)	15.3% (2)	38.4% (5)
No	39.3% (35)	34.9% (22)	61.5% (8)	38.4% (5)
Unknown	10.1% (9)	4.7% (3)	23.0% (3)	23.0% (3)
Treatments received for pain prior to OMCS				
Non-surgical treatment (e.g., reassurance, medications, local therapies, massaging, exercising)	82.0% (73)	79.3% (50)	92.3% (12)	84.6% (11)
Invasive (e.g., Root Canal, surgeries)	80.8% (72)	95.2% 60)	0% (0)	92.3% (12)
Minimally invasive (e.g., injections, arthrocentesis)	29.2% (26)	19.1% (17)	15.3% (2)	53.8% (7)
None	0 % (0)	0 % (0)	15.3% (2)	0 % (0)
Unknown	2 .4% (2)	0 % (0)	15.3% (2)	0 % (0)
History of opioid use for pain				
Yes	26.9% (24)	25.3% (16)	23.0% (3)	38.4% (5)
No	62.9% (56)	68.2% (43)	46.1% (6)	53.8% (7)
Unknown	10.1% (9)	6.3% (4)	30.7% (4)	7.6% (1)

CP-PTP: Chronic post-surgical and post-traumatic pain.
OMCS: Oral medicine clinic service

Nineteen percent of cases had pain intensity on the Likert scale between 8-10 and 43% between 5-7 at initial presentation to the OMCS clinic. Similar proportions were seen in the post-surgical subgroup, while the post traumatic group had fewer (7%) of individuals with pain levels between 8-10. The post-traumatic and concurrent trauma/surgery groups 0-4 pain was more commonly reported during the first OMCS visit (53.8% and 61.5% respectively). The worst pain in the last 6 months was between 8-10 in 52.8% (n=47) of all the CP-PTP subjects. For the CP-PTP post-surgical subgroup, the most commonly reported pain quality descriptors were aching, throbbing, sharp, burning, and shooting. In contrast, for the CP-PTP post-traumatic subgroup the common descriptors were aching, tiring, and exhausting. For the concurrent trauma/surgical CP-PTP subgroup, the associated descriptors included throbbing, sharp, aching, exhausting, and pulling (Table 10).

Table 10.- Pain intensity, descriptors, and qualitative sensory testing

	CP-PTP All groups % (n=89)	**CP-PTP Post-surgery % (n=63)**	**CP-PTP Post-trauma % (n=13)**	**CP-PTP Concurrent trauma and surgery % (n=13)**
Pain intensity at first OMCS visit[1] Median	5	5	3	6.5
0-4	38.2% (34)	38% (24)	53.8% (7)	23.0% (3)
5-7	42.6% (38)	39.6% (25)	38.4% (5)	30.7% (8)
8-10	19.1% (17)	22.2% (14)	7.6% (1)	15.3% (2)
Worst pain level[1] (Past 6 months) Median	8	7	3.5	8.5
0-4	12.3% (11)	11.1% (7)	30.7% (4)	0% (0)
5-7	39.3% (35)	41.2% (26)	30.7% (4)	38.4% (5)
8-10	48.3% (43)	47.6% (30)	38.4% (5)	61.5% (8)
Pain descriptors				
Aching	61%	65.0%	46.1%	53.8%

	(54)	(41)	(6)	(7)
Throbbing	47.1% (42)	49.% (31)		84.6% (11)
Sharp	4% (41)	47.6% (30)	30.7% (4)	53.8% (7)
Burning	32% (29)	39.6% (25)	30.7% (4)	
Shotting	32.5% (29)	46% (29)		
Gnawing			30.7% (4)	
Cramping			30.7% (4)	
Tiring			38.4% (5)	
Tender				38.4% (5)
Exhausting			38.4% (5)	53.8% (7)
Stabbing			30.7% (4)	
Pulling				46.1% (6)
Annoying			30.7% (4)	
Trigeminal QualST				
Allodynia	64% (57)	71.4% (45)	30.7% (4)	61.5% (8)
Normal cranial nerve exam	16% (14)	15.8% (10)	15.3% (2)	15.3% (2)
Paresthesia	8% (7)	1.5% (1)	30.7% (4)	15.3% (2)
Hyperalgesia	3% (3)	3.1% (2)	7.6% (1)	0% (0)
Not clearly detailed	25.8% (23)	25.3% (16)	30.7% (4)	23.0% (3)

[1]: measured on a 0-10 Likert scale
QualST: qualitative sensory testing findings in affected area

The teeth were the most frequent anatomical event location (70.7%), with the most common location being the upper and lower posterior teeth (30.3% and 19.1%). The second most frequent event area was the maxilla and zygomaticomaxillary area (11.2%) followed by the temporal-parietal head area (10.1%) (table 13).

There were more locations experiencing pain than areas that had a specific surgical or traumatic event. For instance, more individuals presented with more pain located in the teeth region (91%) compared with the number of individuals who had dental events (70.7%). Similar trends were

noted for all anatomical areas, such as masticatory muscles (temporalis, masseter area) which had the greatest difference with 51.6% of the individuals presenting with pain in this location compared to 1% that had an inciting event to this area specifically. (Table 13).

3.2.3.-Psychosocial factors and pain impact

The PEG scale mean score was 4.45. Approximately, half of the cases had individual domain scores for pain intensity, interference with enjoyment of life and interference with general activities between 0-4. Between 7-11% of individuals had a high interference with enjoyment of life scoring between 8-10, depending on the subgroup. And between 14-17% had high levels of interference with general activities scoring between 8-10.

Anxiety, and somatization with and without pain were normal or not present for more than half the cases (>50%). Anxiety was moderate or severe in 30% (n=27), somatization with pain was moderate or severe in 44% (n= 39), and somatization without pain was moderate or severe in 33.7% (n= 30) of subjects. Notably, depression was moderate to severe in 47.19% (n=42) (Table 11).

Table 11.- Pain impact, anxiety, depression, and somatization

PEG Scale	CP-PTP All groups % (n=89)	CP-PTP Post-surgery % (n=63)	CP-PTP Post-trauma % (n=13)	CP-PTP Concurrent trauma and surgery % (n=13)
Pain intensity				
0-4	49.4% (44)	46% (29)	61.5% (8)	53.8% (7)
5-7	32.5% (29)	34.9% (22)	23% (3)	30.7% (4)
8-10	13.4% (12)	15.8% (10)	7.6% (1)	7.6% (1)
Interference with enjoyment of life				
0-4	51.6% (46)	52.3% (33)	53.8% (7)	46.1% (6)
5-7	32.5% (29)	34.9% (22)	30.7% (4)	23% (3)
8-10	11.2% (10)	9.5% (6)	7.6% (1)	23% (3)

Interference with general activities				
0-4	56.1% (50)	57.1% (36)	61.5% (8)	46.1% (6)
5-7	22.4% (20)	25.3% (16)	15.3% (2)	15.3% (2)
8-10	16.8% (15)	14.2% (9)	15.3% (2)	30.7% (4)
Unknown	4.4% (4)	3.1% (2)	7.6% (1)	7.6% (1)
PEG Scale Mean score	4.45	4.56	4.07	4.52
SCL-90R domains				
Anxiety normal	61% (54)	60.3% (38)	76.9% (10)	46.1% (6)
Anxiety moderate and severe	30% (27)	30.1% (19)	23.0% (3)	38.4% (5)
Depression None or mild	43.8% (39)	47.6% (30)	23.0% (3)	46.1% (6)
Depression moderate or severe	47.1% (42)	41.2% (26)	69.2% (9)	53.8% (7)
Somatization with pain None or mild	47.1% (42)	53.9% (34)	30.7% (4)	30.7% (4)
Somatization with pain moderate or severe	43.8% (39)	34.9% (22)	69.2% (9)	61.5% (8)
Somatization without pain None or mild	57.3% (51)	63.4% (40)	38.4% (5)	46.1% (6)
Somatization without pain moderate or severe	33.7% (30)	26.9% (17)	53.8% (7)	46.1% (6)
Questionnaire not available	8.9% (8)	9.5% (6)	7.6% (1)	7.6% (1)

3.3.- Specific event associated with the CP-PTP sub diagnosis

The most common sub diagnosis from chronic post-surgical pain was “chronic pain after amputation” (71.9%, n=64). The events in this sub diagnosis category were typically either root canal treatment (RCT) (39.3%, n=35), or dental extractions/dental surgeries (32.5%, n=29). Chronic posttraumatic pain was also sub grouped by type of trauma following ICD-11 categories (figure 1). Peripheral nerve injury and whiplash were the most common, 26.9% (n=24) and 19.1% (n=18) respectively (Table 12).

Table 12.- Surgical and traumatic events

	CP-PTP All groups % (n=89)	CP-PTP Post-surgery % (n=63)	CP-PTP Post-trauma % (n=13)	CP-PTP Concurrent trauma and surgery % (n=13)
Trauma				
CP after peripheral nerve injury / peripheral NP	26.9% (24)		92.3% (12)	92.3% (12)
CP after brain injury /Chronic central NP	4.4% (4)		23% (3)	7.6% (1)
CP after whiplash	19.1% (18)		76.9% (10)	61.5% (8)
CP after musculoskeletal injury	6.7% (6)		23% (3)	23% (3)
Other trauma	1.1% (1)		7.6% (1)	
Surgery				
CP after amputation . -RCT . – Dental Extraction, bone removal or any removal of anatomical parts of the H/N	71.9% (64) 39.3% (35) 32.5% (29)	85.7% (54) 47.6% (30) 38% (24)		76.9% (10) 38.4% (5) 38.4% (5)
CP after dental implants	19.0% (17)	20.6% (13)		30.7% (4)
CP after bone regeneration	7.8% (7)	6.3% (4)		23.0% (3)
CP after restorative work (Veneers, crowns)	5.6% (5)	7.9% (5)		
CP after fracture reduction	3.3% (3)			23.0% (3)
CP after other surgeries [1]	10.1% (9)	7.9% (5)		30.7% (4)

CP: Chronic pain. NP: Neuropathic pain, RCT: root canal therapy. H&N: Head and neck.

[1:] Post-surgical treatments: TMJ surgery (n=2), orthognathic surgery (n=2), face lift (n=1), ENT surgical intervention (n=1), eye surgery (n=1), stylohyoidectomy (n=1), orthodontic treatment (n=1).

3.4.- Other pain conditions and comorbidities co-occurring with CP-PTP

In nearly three-quarters of the cases (n=67) the pain location extended beyond the neuroanatomical location of the event. For CP-PTP 19.1% (n=17) had local pain, while 16.8% (n=15) had regional pain in the head and neck area (masticatory and neck muscles predominantly), and 56.1% (n=50) had pain in at least one location beyond the head and neck defined as widespread for the purposes of this study (shoulders and back predominantly) (table

13). The most common diagnoses in the oral medicine clinic were myofascial pain in 75.2% (n=67) and possible posttraumatic trigeminal neuropathic pain in 64% (n=57) of the sample. Upon chairside qualitative sensory testing of cranial nerve five 64% (n=57) presented with allodynia to light touch (table14).

The most common comorbid pain condition was other non-orofacial musculoskeletal pain present in 45 subjects (50.5%), followed by heart and thyroid disease in 25.8% and 24.7% of the cases respectively. The most frequent pain areas outside of the head and neck were the back, shoulders and lower extremities. Twenty percent of individuals had no medical comorbidities, 42% had 1 or 2 medical comorbidities (excluding their CP-PTP and orofacial pain diagnoses), and 39% had $\geq$3 medical comorbidities with 22% having >5 (table 14).

Table 13.- Location of the surgical or traumatic event, pain and pain extent

Event Characteristics	CP-PTP All groups % (n=89)	CP-PTP Post-surgery % (n=63)	CP-PTP Post-trauma % (n=13)	CP-PTP Concurrent trauma and surgery % (n=13)
Is the pain located only along the anatomical distribution of the event?				
Yes, limited to the event area.	25% (22)	15.8% (10)	53.8% (7)	38.4% (5)
No, includes event area and other surrounding areas	75% (67)	84.1% (53)	51.8% (6)	61.5% (8)
Anatomical location of the craniofacial event				
Teeth	70.7% (63)	84.5% (54)	7.6% (1)	61.5% (8)
Upper posterior teeth	30.3% (27)	36.5% (23)	7.6% (1)	6.3% (3)
Upper anterior teeth	15.7% (14)	17% (11)	0% (0)	23.0% (3)
Lower posterior teeth	19.1% (17)	23% (15)	0% (0)	15.3% (2)
Lower anterior teeth	6.7% (6)	7.9% (5)	0% (0)	7.6% (1)
Maxilla / Malar area/ Zygomatic	11.2% (10)	3.1% (2)	30.7% (4)	30.7% (4)
Head (Temporal, parietal, occipital)	10.1% (9)	1.5% (1)	38.4% (5)	23.0% (3)
Mandible	10.1% (9)	1.5% (1)	23% (3)	38.4% (5)
Supraorbital / frontal	10.1%	0%	46.1%	6.3%

	(9)	(0)	(6)	(3)
Neck	6.7% (6)	0% (0)	30.7% (4)	15.3% (2)
Other	4.4% (4)	1.5% (1)	15.3% (2)	7.6% (1)
Intraoral soft tissues	2.2% (2)	1.5% (1)	0% (0)	7.6% (1)
Submandibular	2.2% (2)	1.5% (1)	7.6% (1)	0% (0)
Nose	1.1% (1)	0% (0)	7.6% (1)	0% (0)
Masticatory muscles	1.1% (1)	1.5% (1)	0% (0)	0% (0)
Unknown	10.1% (9)	0% (0)	38.4% (5)	30.7% (4)
None	20.2% (18)	25.3% (16)	7.6 % (1)	7.6 % (1)
Not documented	2% (2)	0 % (0)	7.6 % (1)	7.6 % (1)
Anatomical location of the pain				
Teeth	91% (81)	100% (63)	38.4% (9)	69.2% (9)
Upper posterior teeth	43.8% (39)	32.5% (29)	30.7% (4)	46.1% (6)
Upper anterior teeth	19% (17)	11.2% (10)	15.3% (2	38.4% (5)
Lower posterior teeth	25.8% (23)	26.9% (17)	15.3% (2)	30.7% (4)
Lower anterior teeth	12.3% (11)	7.9% (7)	1.1% (1)	23% (3)
Masticatory muscles (Masseters, temporalis, pterygoid muscles)	51.6% (46)	50.7% (32)	30.7% (4)	76.9% (10)
Maxilla / Malar area/ Zygomatic	37.0% (33)	28.5% (18)	69.2% (9)	46.1% (6)
Mandible	34.8% (31)	26.9% (17)	53.8% (7)	53.8% (7)
Intraoral soft tissues	31.4% (28)	28.5% (18)	30.7% (4)	46.1% (6)
Neck	28% (25)	20.6% (13)	38.4% (5)	53.8% (7)
Head (Temporal, parietal, occipital)	25.8% (23)	17.4% (11)	53.8% (7)	38.4% (5)
Supraorbital / frontal area	23.5% (21)	14.2% (9)	53.8% (7)	38.4% (5)
Submandibular area	10.1% (9)	3.1% (2)	15.3% (2)	38.4% (5)
Nose	8.9% (8)	9.5% (6)	7.6% (1)	7.6% (1)
Nasopharynx, oropharynx.	1.1% (1)	0% (0)	0% (0)	7.6% (1)
Other	5.6% (5)	6.3% (4)	7.6% (1)	0% (0)
Other pain locations				
Back	42.6% (38)	38% (24)	53.8.% (7)	53.8% (7)

Shoulder	32.5% (29)	25.3% (16)	46.1% (6)	53.8% (7)
Lower extremities	23.5% (21)	17.4% (11)	30.7% (4)	46.1 % (6)
Anterior trunk (Chest/abdomen)	14.6% (13)	12.6% (8)	38.4% (5)	0% (0)
Upper extremities	12.3% (11)	4.7% (3)	15.3% (2)	46.1 % (6)
Not documented	0% (0)	0 % (0)	0% (0)	0 % (0)
Pain extent at 1st OMCS visit				
Local *	19.1% (17)	23.8% (15)	7.6% (1)	7.6% (1)
Regional * *	16.8% (15)	20.6% (13)	15.3% (2)	0% (0)
Widespread * * *	56.1% (50)	55.5% (35)	38.4% (5)	76.9% (10)
Unknown[1]	7.8% (7)	0% (0)	38.4% (5)	15.3% (2)

*Local pain: Located only in the anatomical area of the event.
* * Regional pain: Located in the head and neck area.
* * *Widespread pain: Located in at least one other area beyond the head and neck.
[1]: unknown was assigned to a case if the exact areas of the event (e.g motor vehicle accident) could not be ascertained and thus could not determine if cases had local pain as defined above.

Table 14.- Craniofacial pain diagnoses and medical comorbidities

	CP-PTP All groups % (n=89)	**CP-PTP Post-surgery % (n=63)**	**CP-PTP Post-trauma % (n=13)**	**CP-PTP Concurrent trauma and surgery % (n=13)**
Craniofacial pain diagnoses received at 1st OMCS visit				
Myofascial pain	75.2% (67)	69.8% (44)	76.9% (10)	100% (13)
Possible Post-traumatic trigeminal neuropathic pain *	64% (57)	71.4% (45)	30.7% (4)	61.5% (8)
Primary headaches (TTHA, migraine)	47.1% (42)	41.2% (26)	12.6% (8)	61.5% (8)
Temporomandibular joint pain	24.7% (22)	20.6% (13)	30.7% (4)	38.4% (5)
Burning mouth disorder	15.7% (14)	17.4% (11)	15.3% (2)	7.6% (1)
Trigeminal autonomic cephalalgias	4.4% (4)	3.1% (2)	7.6% (1)	7.6% (1)
None	11.2% (10)	15.8% (10)	0% (0)	0 % (0)
Others [1]	12.3% (11)	9.5% (6)	23% (3)	15.3% (2)
Comorbid medical conditions				
Musculoskeletal pain (excluding craniofacial)	57.3% (51)	52.3% (33)	53.8% (7)	84.6% (11)
Heart disease	25.8% (23)	25.3 % (16)	15.3% (2)	38.4% (5)
Thyroid disease	24.7% (22)	22.2% (14)	38.4% (5)	23.0% (n 3)

Abdominal pain	20.4% (20)	20.6% (13)	15.3% (2)	38.4% (5)
Arthritis	17.9% (16)	14.2 % (9)	38.4% (5)	15.3% (2)
High blood pressure	13.4 % (12)	17.4% (11)	7.6% (1)	0% (0)
Cancer	11% (10)	11.1% (7)	15.3% (2)	7.6% (1)
Others [2]	75.2% (67)	73% (46)	84.6% (11)	76.9% (10)
None	7.8% (7)	9.5% (6)	7.6% (1)	0% (0)
Number of medical comorbidities				
0	19.1% (17)			
1	20.2% (18)			
2	21.3% (19)			
3	10.11% (9)			
4	6.7% (6)			
≥5 (5-12)	22.4% (20)			

*Possible PTTNP based on: chronic pain in a neuroanatomically plausible area, history of peripheral injury, allodynia on qualST.in area of the event.

[1]: Oromandibular dystonia (n=5), bilateral eye pain (n=1), glossopharyngeal neuralgia (n=1), dry mouth (n=1), lichenoid mucositis (n=2), occipital neuralgia (n=1).

[2]: GERD (n=8), lung disease (n=8), rheumatoid arthritis (n=7), bronchitis (n=7), genital herpes (n=6), asthma (n=6), anemia (n=6), kidney disease (n=4), fibromyalgia (n=4), neuropathy (n=3), endometriosis (n=3), kidney disease (n=4), diabetes (n=2), Eagle syndrome (n=1).

3.5.- Feasibility of applying the ICD-11 CP-PTP diagnostic criteria in an oral medicine clinic

The challenges applying the ICD-11 diagnostic criteria to the subject's clinical data most commonly stemmed from incomplete or insufficient detailed documentation about intensity changes in pre-existing pain that followed surgery/trauma, and lack of detail between time of event and onset of pain (e.g., often described as "after surgery" rather than exact event timing). When notes had no details about the onset of pain, cases were not classified as CP-PTP, however this may have been due to providers not asking about trauma or surgery, specifically. Additional challenges were in identifying the true time of onset of the condition. Subjects that presented to

the OMCS years after the event occurred, and/or have had multiple interventions, posed challenges with the detailed memory recall of the pain history.

The subsequent challenges with interpreting the ICD-11 criteria included the lack of definite timeline for CP-PTP diagnosis following a triggering event (i.e., post-operative pain), and the extent of workup needed to identify other causes of pain (e.g., plain film radiographs v. computed tomography, or need for additional diagnostic testing).

CHAPTER 4. DISCUSSION

To our knowledge, this is the first study to apply the ICD-11 criteria for CP-PTP in a sample of individuals with orofacial pain assessed in an oral medicine clinic. The main findings were: 1) 17% of pain subjects met criteria for CP-PTP; thus it is common in this population; 2) a long delay (5 years) in referral was observed; 3) surgery was the most common reason for CP-PTP; 4) the application of ICD-11 criteria is feasible, but clinical information collected can be improved for a more accurate classification.

The prevalence of CP-PTP in our sample was 17% and is consistent with findings in the literature. One population based study reported 18% of individuals with a history of surgery in the last 3 years had pain $\geq$3 months post surgically. [20] Crombie et al., also found similar estimates where 22% of individuals at a pain clinic in northern Britain had post-surgical pain. [2] Published estimates of CP-PTP may vary widely from 5% to 85% due to differences in definition and criteria used for inclusion, as well as location of surgery. [45]

A mean age of 60.5 years was found, three-quarters being females. This is similar to the onset of chronic postoperative pain in extra-craniofacial areas reported by other authors between the 4th and 5th decade of life, with a female predominance. [23,24] However, the exact mechanisms leading

to sex differences in chronic pain prevalence are not fully understood. [46,47] Prior to visiting the OMCS clinic, subjects sought care from a median of 9.5 different clinicians in an effort to relieve their craniofacial pain, with a median duration from start of symptoms to being seen in the OMCS clinic of 60 months. We were not able to ascertain when the patients were first correctly diagnosed with their condition, but it is likely that the majority were either not diagnosed appropriately or managed prior to their first visit in our clinic given the number of providers seen and pain intensity and interference levels individuals presented with. The large number of providers seen could indicate that CP-PTP may be underdiagnosed, difficult to recognize, and/or treat, and, in addition, a significant delay in adequate pain management was likely impacting the patient's quality of life and resulting in unnecessary costs and burden to the health care system. [48] It has previously been reported that individuals with orofacial pain concerns have challenges accessing specialty care and experience increased distress and burden from delays for care. [49]

Average pain intensity was between 8-10 in 13.4% of CP-PTP cases using the PEG scale (last 7 days), and 19.1% using the GCPS (last 6 months). These differences are likely due to differences in time measured by each instrument. In our sample 32% (PEG and GCPS) had pain in the 5-7 range. Lower estimates of pain intensity and interference have been published with 11.8% reporting moderate pain intensity, and just 2.2% of individuals with persistent post-surgical pains showing severe intensity. [23,26,27,50] The reasons for these differences in pain intensity and disability are not clearly understood and should be studied if they correspond to dysregulations in the pain mechanisms or are consequences directly linked to the aggressiveness of the trauma or intervention influenced by the biopsychosocial model, demographic and anatomical location. Other reasons for discrepancies between studies and even within our own sample (PEG scale v.

GCPS) are likely due to differences in the instruments used, PEG measure pain over 7-day as compared to GCPS measuring it over 6 months.

Pain in the same dermatome was present before the initiating event in 50.6% (n= 45) of CP-PTP cases. The medical CP-PTP literature supports the concept that if preexisting preoperative pain exists, a higher risk to develop CP-PTP is present, and each 10% of the time increase in severe pain after surgery has been associated with a 30% increase in the incidence of chronic pain. [10,50]

Regarding the initiating surgical events, our results are consistent (71% surgical of 17.8% post-surgical + post-trauma or combination) (= 12.6%) with the national incidence reports made by various USA authors regarding the frequency of some dental treatments and their respective chronic pain complication rates associated (3 to 13%). [23,25-27] The range in these variations may depend on the type of event described, age, and demographic features. RCT had the highest frequency regarding the initiating surgical events, followed by dental extractions/dental surgeries, and dental implants.

Craniofacial macro-trauma has been described as the most common cause of chronic post-traumatic pain, and 3 to 6 % of subjects with facial fractures can develop chronic neuropathic pain. [23,26,27] In our study 14.6% (n=13) of the CP-PTP cases resulted from trauma. Craniofacial peripheral nerve injury and whiplash were the most common traumatic events in the CP-PTP sample (n=89). Peripheral nerve injury may also occur after surgery and in both cases somatosensory changes frequently present in neuropathic pain can be observed in response to mechanical and cold stimuli negatives (such as hypoesthesia, hypoalgesia, or anesthesia) and/or positives (such as hyperalgesia, allodynia, or dysesthesia), as well as spontaneous and/or evoked pain. [23] One method to detect somatosensory abnormalities is to conduct quantitative sensory testing (QST), however this is a lengthy procedure requiring specialized equipment and expertise

and is not widely available in clinical practice. Another validated method to screen for somatosensory changes is chairside qualitative sensory testing (qualST) by mapping mechanical, thermal, and pinprick sensations on the affected and unaffected sides. [21]

The proportion of craniofacial neuropathic pain in chronic post-surgical pain for the craniofacial region has not been determined. [1] In our CP-PTP sample, 64% had mechanical allodynia to light touch on qualST findings, while contrasting medical studies have found neuropathic features with moderate chronic post-surgical pain in 35.4% of cases following orthopedic surgeries, and 57.1% in severe cases. [50] According to certain writers, hyperalgesia and allodynia may be caused by "sensitization" (central or peripheral). [47,50]

The 64% of the cases that had mechanical allodynia were suspected to have possible post-traumatic trigeminal neuropathic pain (PTTNP). The following factors served as the basis for the diagnosis; pain in a neuroanatomically credible location, a history of trauma or surgery, pain beginning within six months after the incident, and coexisting somatosensory symptoms within the same anatomical distribution. [48] Our proportion of PTTNP is likely an overestimate as qualitative sensory testing is a screening tool and not a definitive diagnostic test, however no previous studies have been conducted on somatosensory abnormalities in individuals using the ICD-11/ CP-PTP criteria for the craniofacial region before. Thus, these estimates should be further investigated and validated. Otherwise, for a definitive diagnosis, tests confirming lesions in the peripheral nerves should be completed.

Three-quarters of the individuals had pain extending beyond the location of the event (table 3). Nineteen percent (n = 17) reported local pain, 16.8% (n = 15) had regional pain in the head and neck region (predominantly in the masticatory and neck muscles), and 56.1% (n = 50) had widespread pain, primarily shoulders and back regions. The most prevalent craniofacial co-

occurring diagnoses with CP-PTP were myofascial pain in 75.2% (n=67) and possible posttraumatic trigeminal neuropathic pain in 64% (n=57) of the cases. These findings could describe central sensitization, caused by deficient pain modulation systems (inefficient inhibition or extensive augmentation) in which a chronic pain in one body region increase the risk of experiencing pain in other areas. Examples include masticatory muscles, cervical spine, or TMJ developing multiple chronic pain conditions (e.g., TNP, migraine, BMD, TMD including CP-PTP). [17,35,43,51] Spreading or secondary muscle-based pain after injury is known to occur in the craniofacial region, and may be occurring here. [52,53]

Previous reports mentioned that TMD subjects are likely to have a history of craniofacial trauma or whiplash, and third molar extractions have been associated with an increased prevalence of TMDs. [17,51,52] The OPPERA study reported an odds ratio ranging from 4.2 to 8.3 regarding the incidence of TMD being more likely in subjects who sustained jaw trauma compared with controls through a delayed response associated with sensitization that promoted the transition from acute to chronic pain. [52] Nociceptive musculoskeletal pain begins with peripheral stimuli, and sensitization as part of the protective function of the nociceptive system occurs, being neuroplasticity, central sensitization, and cortical remodeling symptoms of chronicity, usually amplified by psychological variables that influence pain status. Parafunctional behaviors have also been hypothesized to be related to central dysregulation in the form of overactive motor activation, underactive motor inhibition, loss of normal proprioception, and/or persistent psychophysiological reactivity. The hypothesized central dysregulation may be specific to the masticatory system or may include more general motor activation in addition to that specific to the masticatory system.

Other notable reports mention that the most common corporal musculoskeletal pain is low back pain; with 85% of cases being "nonspecific," meaning that peripheral processes may be responsible for those pains, taking place in the surrounding soft tissues, like muscles or fasciae, rising the idea of myofascial pain, [48] which may be applied to the craniofacial region also. It can be hypothesized that myofascial pain occurs as the result when agonist muscles are overworking to compensate for the lack of assistance received by another muscle group that shares a specific movement, [53] as was observed in the results provided by the subjects self-report during the OMCS pain location.

The most frequent craniofacial event location occurred in the dentition (table 13). Furthermore, it has been shown that the molar and premolar areas are painful in most of the cases. [17,51] Interestingly, 75% of individuals in our sample had pain beyond the location of the event. Again, pain referral, pain spreading and central sensitization as well as the overworked agonist´s muscle theory, may all contribute to this finding.

Half of the subjects showed mild pain intensity and interference with daily activities and enjoyment of life (0-4), whereas the remaining 42% percent had higher levels (>4). Also, for half of the subjects, anxiety, somatization with and without pain were normal; however, 47% (n=42) of the CP-PTP subjects had moderate to severe depression. Some literature supports the idea that subjects with neuropathic pains may be prone to catastrophizing but may not be depressed or anxious. Psychosocial distress is an important risk factor for the development of CP-PTP and plays a role in chronic pain persistence. [6,10,25,54] Psychosocial distress should be routinely screened for and appropriate referrals for multidisciplinary management should be made for optimal care of individuals with CP-PTP.

Some of the strengths of this study should be noted. First, the extensive diagnostic workup and deep clinical phenotyping of the subjects via multiple validated measures in multiple domains was accomplished and detailed clinical notes allowed for the use of the CPTP ICD-11 criteria in the vast majority of subjects screened. Second, the multiple follow-up visits and longer median length of follow up time (14 months) with a team of experienced oral medicine specialists and residents helped to verify the diagnoses and subtypes of the conditions using the biopsychosocial model. Third, the higher volume of pain subjects allowed for a meaningful sample of subjects to describe and summarize. Some variables could be cross referenced from multiple data points such as pain intensity from the PEG and GCPS, as well as widespread pain and medical comorbidity of musculoskeletal pain beyond the head and neck region these were found to have similar findings which strengthens the reliability of each of these results.

The limitations of this study should also be noted. First, the cross-sectional design, and that the sample derived from one Oral Medicine center may not allow generalization to other clinical services or the community. Second, we did identify challenges in determining if some subjects met criteria for CP-PTP, and suggestions to improve history-taking in this area would be valuable. Third, a complete QST exam is strongly suggested by the current literature but was not used in this study to establish sensory disturbance since it is not a feasible clinical chairside test. However, the method we used (qualST) has been validated against the full QST. Fourth, patient recall and provider discrepancy in the collection and documentation, among other clinical findings may have resulted in underreporting of the condition present in the clinic. Lastly, the classifications for local, region and widespread pain were specific to this work, and did not use a specific validated definition. This was in part due to the challenges encountered in defining the spread of pain in individuals with complex histories such as trauma. Future work should

incorporate multisite and-or multicenter studies to analyze different populations, and a variety of dental, head and neck surgery clinics (Endodontics, Oral and Maxillofacial Surgery, Otolaryngology, Headache, Neurology, etc.). This should include standardized interviews and data collection methods to establish a precise prevalence and characterization of CP-PTP in the craniofacial region.

CHAPTER 5. CONCLUSIONS

The craniofacial prevalence of CP-PTP identified in this study constitutes a sizable fraction of the pain subjects seen in the Oral Medicine clinic warranting that dental professionals, oral medicine, orofacial pain and oral surgeons become familiar with and comfortable in applying the diagnostic criteria for CP-PTP. The chronic nature of the condition, long delay before evaluation and diagnosis in a specialty oral medicine clinic, and multiple providers seen indicate that the individual and societal burden of the condition may be high and warrants further investigation. Furthermore, it is likely that many individuals that have a history of CP-PTP receive surgical interventions without being informed of the possible risks for developing new chronic pains or worsening of their previous pain conditions. Future work may investigate preventative strategies by targeting modifiable risk factors (such as managing depression or catastrophizing) and avoiding unnecessary surgical treatments whenever possible.

Early detection of CP-PTP is recommended and serves a number of important purposes, including: 1) warning subjects or providers against procedures that may not be indicated and could make their pain worse, 2) reassessment of the patient to better understand the condition and how it affects quality of life, 3) avoid medico-legal complications for the healthcare professional.

When a patient's primary chief concern resembles myofascial pain, but the reason is not obvious and past surgeries or trauma have occurred, a thorough investigation is necessary. These would include a detailed past and present medical history, a comprehensive clinical exam with complete TMD examination, plus a qualST to determine any possible neuropathic implications associated with it and no less important are the administration and evaluation of psychosocial factors through validated forms, to establish a precise diagnoses and determine appropriate therapies.

APPENDIX

Appendix 1.- ICD –10 pain codes

ICD-10 codes	ICD-10 codes
S04.10: Injury of oculomotor nerve, unspecified side	S04.71XS: - Injury of accessory nerve, right side, sequela
S04.10XA Injury of oculomotor nerve, unspecified side, initial encounter	S04.72: Injury of accessory nerve, left side
S04.10XD: Injury of oculomotor nerve, unspecified side	S04.72XA: Injury of accessory nerve, left side, initial encounter
S04.10XS injury of oculomotor nerve, unspecified side, sequela	S04.72XD: Injury of accessory nerve, left side, subsequent encounter
S04.11 Injury of oculomotor nerve, right side	S04.72XS: Injury of accessory nerve, left side, sequela
S04.11XA Injury of oculomotor nerve, right side, initial encounter	S04.811: Injury of olfactory 1st nerve, right side
S04.11XD: Injury of oculomotor nerve, right side, subsequent encounter	S04.811A: Injury of olfactory 1st nerve, right side, initial encounter
S04.11XS: Injury of oculomotor nerve, right side, initial encounter	S04.811D: Injury of olfactory 1st nerve, right side, subsequent encounter.
S04.12 Injury of oculomotor nerve, left side	S04.811S: Injury of olfactory 1st nerve, right side, sequela.
S04.12XA Injury of oculomotor nerve, left side, initial encounter	S04.812: Injury of olfactory 1st nerve, left side
S04.12XD: Injury of oculomotor nerve, left side, subsequent encounter	S04.812A: Injury of olfactory 1st nerve, left side, initial encounter
S04.12XS: Injury of oculomotor nerve, left side, sequela	S04.812D: Injury of olfactory 1st nerve, left side, subsequent encounter
S04.20: Injury of trochlear nerve, unspecified side	S04.812S: Injury of olfactory 1st nerve, left side, sequela
S04.20XA: Injury of trochlear nerve, unspecified side, initial encounter	S04.819: Injury of olfactory 1st nerve, unspecified side
S04.20XD: Injury of trochlear nerve, unspecified side, subsequent encounter	S04.819A: Injury of olfactory 1st nerve, unspecified side, initial encounter
S04.20XS: Injury of trochlear nerve, unspecified side, sequela	S04.819D: Injury of olfactory 1st nerve, unspecified side, subsequent encounter
S04.21: Injury of trochlear nerve, right side	S04.819S: Injury of olfactory 1st nerve, unspecified side, sequela
S04.21XA: Injury of trochlear nerve, right side, initial encounter	S04.891: Injury of other cranial nerves, right side.

S04.21XD: Injury of trochlear nerve, right side, subsequent encounter	S04.891A: Injury of other cranial nerves, right side, initial encounter
S04.21XS: Injury of trochlear nerve, right side, sequela	S04.891D, Injury of other cranial nerves, right side, subsequent encounter
S04.22: - Injury of trochlear nerve, left side	S04.891S: Injury of other cranial nerves, right side, sequela
S04.22XA: Injury of trochlear nerve, left side, initial encounter	S04.892: Injury of other cranial nerves, left side
S04.22XD: Injury of trochlear nerve, left side, subsequent encounter	S04.892A: Injury of other cranial nerves, left side, initial encounter
S04.22XS: Injury of trochlear nerve, left side, sequela	S04.892D: Injury of other cranial nerves, left side, subsequent encounter
S04.30: Injury of trigeminal nerve, unspecified side	S04.892S: Injury of other cranial nerves, left side, sequela
S04.30XA: Injury of trigeminal nerve, unspecified side, initial encounter	S04.899: Injury of other cranial nerves, unspecified side
S04.30XD: Injury of trigeminal nerve, unspecified side, subsequent encounter	S04.899A: Injury of other cranial nerves, unspecified side, initial encounter
S04.30XS: Injury of trigeminal nerve, unspecified side, sequela	S04.899D: Injury of other cranial nerves, unspecified side, subsequent encounter
S04.31: Injury of trigeminal nerve, right side	S04.899S: Injury of other cranial nerves, unspecified side, sequela
S04.31XA: Injury of trigeminal nerve, right side, initial encounter	S04.9XXA: Injury of unspecified cranial nerve, initial encounter
S04.31XD: Injury of trigeminal nerve, right side, subsequent encounter	S04.9XXD: Injury of unspecified cranial nerve, subsequent encounter
S04.31XS: Injury of trigeminal nerve, right side, sequela	S04.9XXS: Injury of unspecified cranial nerve, sequela
S04.32: Injury of trigeminal nerve, left side	M79. 10: Myalgia, unspecified site
S04.32XA: Injury of trigeminal nerve, left side, initial encounter	M79.11: Myalgia of mastication muscle
S04.32XD Injury of trigeminal nerve, left side, subsequent encounter	M79.12: Myalgia of auxiliary muscles, head and neck
S04.32XS: Injury of trigeminal nerve, left side, sequela	G44: Other headache syndromes
S04.40: Injury of abducent nerve, unspecified side	G44.8: Other specified headache syndromes
S04.40XA: Injury of abducent nerve, unspecified side, initial encounter	G44.89: Another headache syndrome
S04.40XD: Injury of abducent nerve, unspecified side, subsequent encounter	G90: Disorders of autonomic nervous system
S04.40XS: Injury of abducent nerve, unspecified side, sequela	G90.5: Complex regional pain syndrome I (CRPS I)
S04.41: Injury of abducent nerve, right side	G90.59 - Complex regional pain syndrome I of another specified site
S04.41XA: Injury of abducent nerve, right side, initial encounter.	R51.9 - Headache, unspecified
S04.41XD: injury of abducent nerve, right side, subsequent encounter	G50.1 - Atypical facial pain
S04.41XS: injury of abducent nerve, right side, sequela	R25.1: Tremor, unspecified
S04.42: Injury of abducent nerve, left side	G24.4: Idiopathic orofacial dystonia
S04.42XA: Injury of abducent nerve, left side, initial encounter	G24.8 Other dystonia
S04.42XD: Injury of abducent nerve, left side, subsequent encounter	G24.9 - Dystonia, unspecified
S04.42XS: Injury of abducent nerve, left side, sequela	M67.90: Unspecified disorder of synovium and tendon, unspecified site
S04.50: Injury of facial nerve, unspecified side	G50.0 for trigeminal neuralgia

S04.50XA: Injury of facial nerve, unspecified side, initial encounter	G43.109: Migraine with aura, not intractable, without status migrainosus.
S04.50XD: Injury of facial nerve, unspecified side, subsequent encounter	G44.00 - Cluster headache syndrome, unspecified
S04.50XS: Injury of facial nerve, unspecified side, sequela	G44.001 - Cluster headache syndrome, unspecified, intractable
S04.51: Injury of facial nerve, right side	G44.009 - Cluster headache syndrome, unspecified, not intractable
S04.51XA: Injury of facial nerve, right side, initial encounter	G44.20 - Tension-type headache, unspecified
S04.51XD: Injury of facial nerve, right side, subsequent encounter	G44.201 - Tension-type headache, unspecified, intractable
S04.51XS: Injury of facial nerve, right side, sequela	G44.209 - Tension-type headache, unspecified, not intractable
S04.52: Injury of facial nerve, left side	G44.30 - post-traumatic headache, unspecified
S04.52XA: Injury of facial nerve, left side, initial encounter	G44.301 - post-traumatic headache, unspecified, intractable
S04.52XD: Injury of facial nerve, left side, subsequent encounter	G44.309 - post-traumatic headache, unspecified, not intractable
S04.52XS: Injury of facial nerve, left side, sequela	G44.32 - Chronic post-traumatic headache
S04.60: Injury of acoustic nerve, unspecified side	G44.8 - Other specified headache syndromes
S04.60XA: Injury of acoustic nerve, unspecified side, initial encounter	G44.89 - Another headache syndrome
S04.60XD: Injury of acoustic nerve, unspecified side, subsequent encounter	R52: pain unspecified
S04.60XS: Injury of acoustic nerve, unspecified side, sequela	G89.18 - Other acute postprocedural pain
S04.61: Injury of acoustic nerve, right side	G89.28 - Other chronic postprocedural pain
S04.61XA Injury of acoustic nerve, right side, initial encounter	J32.8 - Other chronic sinusitis
S04.61XD: Injury of acoustic nerve, right side, subsequent encounter	J32.9 - Chronic sinusitis, unspecified
S04.61XS: Injury of acoustic nerve, right side, sequela	M79.7 Fibromyalgia
S04.62XA: Injury of acoustic nerve, left side	M62.83 - Muscle spasm
S04.62XD: Injury of acoustic nerve, left side, subsequent encounter	G89.28 - Other chronic postprocedural pain
S04.62XS: Injury of acoustic nerve, left side, sequela	T88 - Other complications of surgical and medical care, not elsewhere classified
S04.70: Injury of accessory nerve, unspecified side	T88.8 - Other specified complications of surgical and medical care, not elsewhere classified
S04.70XA: Injury of accessory nerve, unspecified side, initial encounter	G52.1 - Disorders of glossopharyngeal nerve
S04.70XD: Injury of accessory nerve, unspecified side, subsequent encounter	K14 - Diseases of tongue
S04.70XS: Injury of accessory nerve, unspecified side, sequela	K14.6 - Glossodynia
S04.71: Injury of accessory nerve, right side	G44: Other headaches syndromes
S04.71XA: Injury of accessory nerve, right side, initial encounter.	G44.3 - post-traumatic headache
S04.71XD: Injury of accessory nerve, right side, subsequent encounter	

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