Medication Use and Recovery in Orthognathic Surgery Patients

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ABSTRACT

JARED C BLACKER: Medication Use and Recovery in Orthognathic Surgery Patients
(Under the direction of Ceib Phillips)

Recovery from orthognathic surgery usually involves returning to pre-surgical levels of activity and function. In this study, orthognathic surgery patients were given a daily diary to keep for 90 days post-surgery. The diary measured recovery in four domains: post-surgery sequelae, discomfort/pain, oral function, and daily activities. This study evaluated the effect of medication use in patients on their reported recovery measures. Multifactorial analysis according to age ($\leq$ 18y, >18y), gender, type of surgery (maxilla, mandible, two-jaw surgery), and opioid analgesic use ($\leq$ 7 days, >7 days) was performed. Opioid use was significant as an interaction with age in some measures of the post-surgery sequelae domain. Age had a significant main effect in daily activities, and significant interaction with type of surgery in oral function, post-surgery sequelae and pain/discomfort. Older patients were more disparate in recovery according to type of surgery, while younger patients recovered more similarly given any type of surgery.

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I. Introduction

Recovery from orthognathic surgery involves many components that will be faced by a surgery patient. There are reasons it is important to describe the anticipated amount of time before recovery. First, informed consent is based on communicating known information to the patient, so that patient may give consent to any recommended procedure. Second, as far as we know recovery from surgery in some areas may take at least a week or more, and planning the convalescent period in terms of time off from work, needed care giving for the patient, and making time for follow-up visits are also concerns. Any information we can gain from observing patients in the recovery period may be helpful in communicating realistic expectations to future orthognathic surgery patients. Any factors that may alter or otherwise affect those observations may also be useful for patients to be aware of before surgery.

A structured diary is one way to record observations during the recovery period. While some studies have asked for observations that summarize a week or more of recovery,[1, 2] a diary may be used for the time period immediately post-surgery.[3] This method has been used previously in recovery from third molar surgery/extraction[3] and more recently in an orthognathic surgery patient cohort.[4, 5] After obtaining information in the form of structured diaries, it may be possible to assess factors that may elongate or shorten recovery times.

Prescribing medication for various reasons is common after orthognathic surgery.[6] Antibiotics, analgesics, anti-inflammation agents may be prescribed for patients.[7-9] By evaluating the effects of taking medications for specific periods of time it may be possible to understand better those recovery measures that either drive medication use, are affected by it, or are not influenced in either way.

II. Literature Review

Introduction

A post-surgical diary to record sequelae, complications, and recovery measures has been used to document patient reported outcomes. Ultimately, the goal of keeping the diary is to capture data at fixed intervals (e.g. daily) that would otherwise be difficult to obtain. In a situation like recovering from surgery, it proves difficult to have a subject respond to questions during post-surgical visits if the study protocol demands daily entries, yet the post-surgical visits occur at weeks or months post surgery.

Use of Diaries

Many reports have been published regarding Health Related Quality of Life (HRQoL) relating to orthognathic surgery,[1, 10-21] but the designs of those studies included gathering summarical post-surgery data (e.g. at 1 week, 4-6 weeks, etc.) which often coincides with the normal recall for the patients; i.e. the instruments used at these visits may ask for a summary of a time period that may be too long to demonstratively record changes in recovery measures that occur in hours or days. For instance, the Oral Health Impact Profile (OHIP-14)[2] asks patients to respond to questions as they recall events over the last 14 days, while the Post-Surgical Perceptions (PSP)[1] asks for responses to summarize the previous 7 days. For those sequelae that may resolve sooner than a week, i.e. days or hours, other instruments and protocols are needed.

Structured diaries are one such method of recording information from a shorter period of time, and have been used to capture information from patients following surgery.

Parsons, Cordes and Comer[22] used data from patient journals to assess differences in patient recovery after using different surgical devices in tonsillectomy surgeries. Their study included 134 surgery patients who were asked to complete the post-surgical diary for 10 consecutive days. The diary included a pain scale (Wong-Baker FACES pain rating scale[23]) and "questions about food intake, activity level, need for pain medication, and any complications experienced by the patient."

Tan et al[24] also used diaries to assess pain and a few recovery measures after tonsillectomy procedures. The 67 patients were asked to keep the diary for 21 days, during which the subject was asked to answer five questions: "1) visual analog score for pain of 0 to 10, 0 being no pain and 10 being extreme pain; 2) number of tablets of analgesia taken for that day; 3) ability to take normal diet; 4) ability to return to normal activities; 5) experience of pain on swallowing."

Young and O'Connell[25] used diaries to measure differences in recovery in patients who had laparascopic cholecystectomy in either a 23 hour or 8 hour facility. 28 patients were recruited and completed diaries for immediately post-surgical days. The respondents reported scores on "tiredness, mobility, pain, eating and drinking, nausea and vomiting, elimination, wound management, discharge information and management of postoperative recovery."

Patient diaries are also used in many post-dental surgery recovery reports. Froum et al[26] used a diary card to have patients report on adverse events that occurred following the use of an Enamel Matrix Derivative (EMD) in the treatment of infrabony defects. The study involved 376 patients form 11 university based postgraduate periodontal programs and 5 private practices. The diary in this study took the form of a card that the patient was instructed to complete as a summary for week 1 and week 2 post-surgery. The card asked questions regarding "adverse events" and the data were recorded onto a case report form after being returned by the patient at follow-up appointments.

Nusstein, Reader and Beck[27] gave a diary to their 124 subjects to record "pain, percussion pain, swelling, and number and type of pain medication taken" after accessing, and drainage of, the pulp chamber in symptomatic necrotic teeth. The diary keeping in this study occurred daily over a period of 6 days with the diaries being retuned at a follow-up visit.

Nist, Reader and Beck[28] also used a diary to assess the efficacy of apical trephination treatment on symptomatic necrotic teeth. The 7-day, daily-diary also recorded "pain, percussion pain, swelling, and number and type of pain medication taken". Data were recorded on 50 adult patients, who were all instructed to complete the diary upon awakening on a given day. The diary was returned at a return visit as well.

Kearns, McCartan and Lamey[29] reported on the pain experience of 85 consecutive patients following biopsy of an oral mucosal lesion under local anesthesia. The diary recorded three items: "the overall level of pain, the worst pain experienced and whether analgesics had been taken" over 7 post-operative days. In this diary a Visual Analog Scale (VAS) was used for pain scores.

Heard et al[30] also used a diary card to report on pain related sequela and wound healing in 32 patients who received EMD for the treatment of intrabony defects. The diary card used in the study asked patients to give responses in the areas of "presence and severity of headaches, root hypersensitivity, tooth pain, swelling, and itching". The diaries were kept for 5 immediately post-surgery days. Each question was in the form of Y/N with an accompanying question regarding the intensity of any "yes" answers (mild, moderate, or severe). The data from the diaries were collected and compared at follow-up visits.

Houck et al[31] used a 7 day diary to record "pain, percussion pain, swelling, and number and type of pain medication taken" in patients who underwent trephination treatment for symptomatic necrotic teeth. Patients were instructed to complete the diary upon awakening and were asked to rate the different measures on a scale from 0 to 3, zero indicating no problem. Diaries were collected at a follow up visit and verified for medication use.

Malstrom et al[32, 33] twice used a diary to assess the efficacy of COX-2 inhibitors in the treatment of acute dental pain. After the extraction of at least 2 third molars, patients were asked to observe and record "pain intensity, pain relief, and global evaluations throughout the 24-hour period after dosing". The diaries were used at the testing facility for the 8 hours following extraction, and then completed at 10, 12, and 24 hours post-surgery with the patients being reminded to complete the diary after receiving a phone call.

Pearlman et al[34] used a patient diary to report on the efficacy of ibuprofen administration after periodontal surgery. Patients were asked to record observations on "quantity and time of medication and regular assessment of pain experience utilizing a visual analogue scale". The 127 patients recorded scores in the diaries at either times when the patient was directed to take medication or at directed those same directed times (however, without also taking medication) and times when medication was deemed necessary by the patient. The diary was kept until bedtime on the day of the surgery.

In 1996, Cooper et al[35] published a report to assess the efficacy of co-administration of misoprostol with NSAIDS which recorded pain levels for 6 hours post-surgery in a patient diary. The publication reported on two studies including 70 patients in each study, differing in design by the type of NSAID used in combination with misoprostol. The diaries were recorded in by the patient at 15, 30, 45 min and 1hour post-intervention/administration of medication and then every hour until 6 hours.

In 1993 Cooper was again the lead author on a report that used a 12 hour diary to assess the efficacy of a time-release form of ibuprofen in the treatment of dental pain.[36] 120 subjects were involved in the study and recorded in the diary to reports pain levels during post-intervention time periods of 1-4 hours, 5-8 hours and 9-12 hours or until rescue medication was need. The diary was returned to the researchers at a follow-up visit.

Marti et al[37] used a self-report diary to assess the pain experience after minor dental surgery in patients who were taking either lysine clonixinate (NSAID) or paracetamol (acetaminophen). These diaries were used for 48 hours following intervention or until pain resolution and directed the patient to report on pain levels using a VAS and other variables like “facial swelling and night pain”.

Tai and Baker[38] had 52 patients complete a daily diary for one week post surgery for the removal of two lower third molars. The diary was used to record "pain scores, consumption of paracetamol, dental bleeding, dysphagia and sleep disturbance” in patients who were administered either controlled release ketoprofen or diclofenac as an analgesic for pain control after removal of lower third molars.

Other studies have used diaries as an end to collect and report on the recovery of subjects, not just the means to compare different interventions. Conrad et al[39] and White et al[3] used diaries to evaluate HRQol measures as patients recovered from third molar surgery. Both studies utilized a 14 day diary keeping period to assess measures related to recovery. The report from Conrad et al included diaries from 249 patients which evaluated patients along 4 main categories including pain, lifestyle, oral function and other symptoms. White et al used a similar diary to publish a follow-up report which involved 630 subjects. Foy et al[40], Phillips et al[41], and Stavropolous et al[42] used White et al’s 14 day diaries to assess potential risk factors for prolonged recovery in patients who underwent third molar removal.

More recently, Phillips and Blakey[5] used a modified version of the White et al[3] 14 day diary to assess recovery measures in orthognathic surgery patients. One of the modifications made was to lengthen the time of diary completion by the patients from 14 to 90 days. 87% of 170 enrollees completed the 90 day protocol, with younger patients being more likely to complete the entire 90 day diary.

Phillips, Blakey, and Jaskolka[4] reported the outcomes from the use of those 90 day diaries from the 170 patients including recovery times for the measures as asked in the diaries. The authors assessed 4 recovery domains: post-surgery sequela, discomfort/pain, oral function, and daily activities. All measures used a 5 point Likert-type scale, except for discomfort/pain which used a 7 point Likert-type scale. With the type and amount of data recorded, those authors were able to report on median recovery times for the measurements listed in the diary.

Use of Medication Post-Surgery

Prescribed medications for post-oral surgery sequelae can take the form of narcotics/opioids, non-steroidal anti-inflammatory drugs (NSAIDS), non-NSAID analgesics (acetaminophen), antibiotics, and others.[6] Currently, the body of literature which recommends one type of medication use or another is replete with studies using a third molar extraction with or without impaction model,[32-38, 43-56] or another type of dental surgery model, viz. periodontal surgery.[57] For example, Tucker, Smith and Adams[57] compared the effectiveness of using etodolac (NSAID) as opposed to a standard acetaminophen and hydrocodone (opioid) regimen in periodontal surgery population. Chang et al[47, 53, 58] published results from several randomized clinical trials comparing the efficacy of rofecoxib (NSAID) in relieving surgical extraction of third molars to opioid and/or acetaminophen combinations. Korn et al[48] also published findings from a similar cohort in a randomized clinical trial, but in this report comparing rofecoxib to an oxycodone/acetaminophen combination. While both studies found a greater analgesic effect in those patients in the NSAID group, rofecoxib was recalled by its manufacturer Merck in 2004.[59]

There exist a few reports which have published post-surgical medication use in an orthognathic surgery patient population. Antibiotics may be one class of medications prescribed to orthognathic surgery patients. Chow et al[7] and Zijderveld et al[60] reported that pre-operative intravenous administration of an antibiotic reduced the number of infections associated with orthognathic surgery. Foy et al[40] published similar findings in patients who had removal of third molars.

Samman and Cheung[61] reported on a prospective randomized clinical trial which involved 160 orthognathic patients being assigned to groups designated by increasing regimens of pre/post-surgical antibiotics. While the overall infection rate was small for the cohort (16%), a significant difference was found between the group receiving the lowest amount of antibiotics (higher number of infections) and the group who received the greater dose of antibiotics.

Steroids may be another class of drug prescribed for orthognathic surgery patients. Zuniga[9] stated that steroid therapy may be useful in those patients who suffer inferior alveolar nerve damage during mandibular surgery, especially during bi-lateral sagittal split osteotomy (BSSO).

Weber and Griffin[62] reported on their randomized clinical trial involving 23 patients and the use of dexamethasone (a steroid). Their findings included a reduced amount of edema experienced post-operatively. The swelling was examined photographically, while c-reactive protein, an indicator of inflammation was taken via blood sample and showed decreased amounts in those patients who received dexamethasone.

Schaberg, Stuller and Edwards[63] reported their finding and conclusion that methylprednisolone (a steroid) decreased the amount of swelling experienced by orthognathic surgery patients. Their study included 39 patients who were assessed for edema post-surgically via computed tomography (CT) scans at 24 and 72 hours post-operatively.

Analgesics like NSAIDS, non-NSAIDS (e.g. acetaminophen) and opioids are often prescribed for orthognathic surgery patients. Tuzuner et al[64] report on their clincical trial where pre-operative use of tramadol (synthetic opioid) or diclofenac sodium (NSAID) were evaluated for their effect on post-surgical consumption of intravenous opioids. Their study reported findings from a cohort of 36 patients who underwent both LeFort 1 maxillary advancement and BSSO as part of simultaneous bi-maxillary surgery. While both tramadol and dicolfenac sodium gave more effective relief of pain than placebo, no difference emerged between the two medications.

Nagatsuka, Ichinohe, and Kaneko[65] also reported on the preemptive effects of a medley of medications on the post-surgery pain experiences of orthognathic surgery patients. The medley of medications studied did not seem to cause the anticipated effect, as no differences were found between the experimental and control groups.

Precious et al[66] report from their study involving 75 subjects in 1997 where they compared post-operative pain management regiments of "patient-controlled intravenous (IV) opioid analgesic administration (PCA) with fixed schedule and dosage oral/rectal administration of naproxen, and opioid analgesics intramuscularly/orally as needed (IM/po prn) for postoperative analgesia over a period of 48 to 56 hours." Their findings included patients who were on the PCA and naproxen regiments reporting greater pain management compared to the codeine group, and that the codeine group experienced greater post-surgical nausea.

Evans, Levine and Bahn[8] reported in 1976 about post-operative medication needs as observed in 45 recovering orthognathic surgery patients. These authors remarked that a number of factors might contribute to severe pain during recovery, and therefore an opioid (i.e. more potent) drug may be needed. In the cases reported, opioids, aspirin and acetaminophen were used to obtain adequate analgesia for post-surgery pain.

Interestingly, Ichinohe and Kaneko[67] reported that administering nitrous oxide during orthognathic surgery did not aggravate post-operative nausea and vomiting (PONV) in the 28 female patients who participated in their study. Silva, O'Ryan, and Poor[68] who reported that PONV is a common complaint among those who have undergone orthognathic surgery, and reported post-operative use of opioids as being a risk factor for PONV.

III. Methods

Patients

This study was approved by the Biomedical Institutional Review Board. Subjects who were scheduled for an orthognathic surgical procedure after presenting with a dentofacial disharmony agreed to participate in a prospective clinical study. Exclusion criteria included previous facial surgery; congenital anomaly or a history of acute facial trauma; medical condition associated with systemic neuropathy (e.g. diabetes, hypertension, kidney problems); pregnancy; or inability to follow written English instructions or unwilling to sign informed consent. The project was described by a research associate after which HIPAA authorization and written consent/assent were obtained. Demographic information including age, gender, and race was collected before surgery. Surgery was performed by oral and maxillofacial surgery faculty and residents at UNC Hospitals. All patients had orthodontic appliances in place at the time of surgery and rigid fixation to stabilize bony jaw segments.

Instrument

OSPostop, a patient-reported HRQoL structured diary,[5] was used following orthognathic surgery. Subjects were instructed to record perceived measures each post-surgery day for 90 days. The diary assessed four main areas: 1) post-surgery sequelae (feeling anxious, trapped, bleeding, bruising, nausea, food collection in the soft tissue incision, food collection around teeth, bad breath/bad taste, swelling); 2) discomfort/pain (worst, average, medication use); 3)oral function (opening, chewing, and biting foods); and 4) daily activity (sleeping, routine, social and recreational activities). The discomfort/pain items were rated on Likert-like scales from No Discomfort (1) to Worst Imaginable (7). All other items were rated from No Trouble/Concern (1) to Lots of Trouble/Concern (5). The subject was also requested to record whether medications had been taken for discomfort/pain and if so, what medications were taken (Appendix).

Research associates met with the subjects at each clinical visit with the surgical attending. Subjects were instructed to bring their diaries with them to follow-up visits occurring at one, four to six, and twelve weeks. Research associates contacted subjects and requested the return, via postal service, of any diaries not collected because of a missed clinical visit or the subject neglecting to bring the diary with them to an appointment.

A patient's daily response to each of the items was dichotomized as no substantial interference or "little or no trouble/discomfort" as indicated by a 1 or 2 on the 5 point and 7 point Likert-type scales and some substantial interference "some, quite a bit, or lots" as indicated by a response of 3 or higher on the 5-point and 7-point Likert-type scale for discomfort/pain. Any day when a subject reported a 3 or higher was designated as a Problem Day (PD). The number of PD for each measure within the four domains were then totaled and then compared using the factors of age, gender, type of surgery and opioid use.

Analysis

Multifactorial ANOVA analysis was used to determine significant differences in the number of problem days and interactions between the factors within the diary measured domains. All calculations were performed with SPSS 14.0 and the null rejection value was set at $p \leq .05$.

IV. Results

188 patients consented to participate in the study and completed at least the first 30 days of the diary. The patients who participated were primarily female (66.5%) and Caucasian (82.4%). 36.7% had a two jaw procedure, 37.8% had a maxillary procedure only and 25.5% had a mandibular only procedure (Table 1). Participants ranged in age from 13.9 years to 53.2 years (median = 18.5 years; IQR = 16.9-25.1 years).

Subject factors included the number of days of opioid analgesic use ($\leq$ 7 days and >7 days), gender, age ($\leq$18 y, >18y), and type of surgery (maxilla only, mandible only, and two jaw). Multifactorial ANOVA was conducted to evaluate the effect of these factors on the number of problem days by domain that were reported in the diaries. The domain of Post-surgical sequelae were further segmented into acute (bruising, bleeding, nausea, feeling trapped, feeling anxious) and longer term (swelling, bad taste in the mouth, food collecting between teeth, and food collecting in incisions). This was based on the mean number of problem days for the cohort as a whole (see Table 2).

In the oral function domain none of the main effects were significant, however, the interaction between age and surgery was statistically significant (*p=.047*); in the corrected model all measures were significant: eating (*p=.005*), chewing (*p=.041*), and opening (*p=.001*). In the daily activity domain only the main effect of age was significant (*p=.012*), however, there were no significant interactions between the factors; in the corrected model the measures of sleeping (*p*=.003) and social activities (*p=.019*) were significant. For acute sequelae, the main effect of gender was significant (*p=.003)*, yet there were again no significant interactions; however in the corrected model, bleeding was the one measure that was significantly different (*p=.013*). For longer term sequelae, the main effect of type of surgery was significant (*p*=.010), while the interactions between age and surgery (*p*=.015), and age and opioid use (*p*=.035) were also significant; in the corrected model swelling (*p=.035*), food collecting between or behind teeth (*p<.001*), and food collecting in soft tissue incisions (*p=.008*) were all significant. Finally, for the discomfort domain no main effects were statistically significant, yet the interaction between age and surgery was again significant (*p*=.025); in the corrected model worst pain was significant (*p=.037*). The factors' main effects and two way interactions for oral function measures, daily activity measures, post-surgery sequelae, and discomfort are summarized in Tables 3 and 4. Corrected model significance levels are shown in Table 5.

V. Discussion

Analysis

The analysis of the data by PD allowed the study to overcome a definitional problem that would occur had we approached the data as a survival or "time to event" statistical model. In other words, if the event of "resolution" is defined as the first pain free day, it becomes problematic to know how to treat a report of a painful day that occurs 3 days after the first pain free day. By comparing total PD among the cohort, we are able to report the total number of PD a patient experiences at the cost of knowing how many of the PD occur consecutively; e.g. a patient may report 23 anxiety problem days, but the 23rd problematic day may have occurred at post-surgical day 29. It seems reasonable to argue for reporting the data based on total PD, rather than a "time to resolution", so that patients and their providers may be more aware of the total burden of the surgery, which may otherwise go undefined.

Data

Age appeared to be the strongest determinant in our results, being significant as a main effect and as part of an interaction. As a main effect, age was significant for the daily routine domain. As a group, the younger patients appeared to have greater extremes in this domain, the younger patients report on average less trouble in sleeping PD than older patients, but more PD in the sports and hobbies measures (see Figure 1). This could be a reflection of the schedules of young patients, many of whom may be engaged in more sports and activities on a daily basis than working or college age adults. As for sleep disturbance, it appears that older patients report more PD than those younger patients.

Wang et al[69] reported that patients who self-medicated after thoracotomy surgery experienced better pain control and less sleep disturbance than those who were given IM analgesics. While the opioid use was not a significant main effect on this domain, in the corrected model, sleep was significantly different ($p=.003$), and those in the Op7+ group on average reported fewer sleep PD.

Gender was significant as a main effect on the domain of acute post-surgical sequelae. We see females reporting more PD in bruising, nausea, feeling anxious and feeling trapped than males, but males reporting more PD with bleeding (See Figure 2). While Silva et al[68] reported females being more predisposed to nausea post orthognathic surgery, the only acute sequelae measure that was significant in our corrected model was bleeding ($p=.013$).

Type of surgery was significant as a main effect for longer term post-surgical sequelae (See Figure 3). Involvement of the mandible either alone or in two jaw surgery tended to result in more reported PD for a bad taste in the mouth, and food collecting in between teeth and soft tissue incisions. Involvement of the maxilla, either alone or in two-jaw surgery resulted in more swelling PD. In our corrected model, swelling ($p=.035$), food collecting between teeth ($p<.001$), and food collecting in soft tissue incisions ($p=.008$) were all significant.

Age and surgery had significant interactions in three of the domains: oral function, longer term sequelae, and discomfort. Younger patients seemed to be grouped closer together in PD among the oral function measures, i.e. the younger patients in all types of surgery had mean PD within 7 days of each other, which was not the case with older adults. The type of surgery had a greater impact on PD in older patients. In older patients involvement of the mandible, either in mandible only or two jaw surgery, seemed to cause more PD (see Figure 4). This may be an important factor in recommending one type of surgery or another to an older patient, especially in those surgery centers who tend to recommend more mandible only procedures than maxilla only procedures, as a matter of experience.

The interaction between age and surgery in longer term sequela also show a greater discrimination between surgery type in the older patient than the younger, especially in the measures of food collecting between teeth or in soft tissue incisions, and a bad taste occurring in the mouth. Again, involvement of the mandible in older patients seems to influence greater PD reporting. Swelling appears to bother younger patients more when there has been involvement of the maxilla, as opposed to two jaw surgery having generally more PD than either single jaw surgery in older patients (see Figure 5). Kau, Cronin, and Richmond[70] report that swelling is greater in two jaw surgery as measured by soft tissue laser scanning, which is suggested by the number of PD reported by the age groups, but the involvement of the maxilla in younger patients, being closer to two jaw surgery in terms of PD, is noteworthy.

Similar trends as those in longer term sequelae are seen in the discomfort measures, where involvement of the maxilla tends to cause more PD in average pain in the younger patients, but worst pain is similar across all three surgeries in the younger group. Older patients report more PD in worst pain and average pain among those who have two jaw surgery, yet maxilla only surgery tends to be the lowest in PD in these measures (Figure 6).

Age and opioid use had a significant interaction on longer term sequelae. From this interaction we see that in every instance the older patients in the Op7 group reported greater PD than those in the Op7+ group. As well, those in the Op7+ group were more closely similar in reported PD than those in the Op7 group across the age groups (see Figure 7). This is an interesting finding, due to the fact that opioid analgesics are not generally used in the treatment of those long term sequelae, but what it may suggest is a tendency for those older Op7 subjects to go without analgesia for whatever the cause; this could be a reflection of a watchful parent being able to administer analgesics to his or her child, or a self-responsible adult not wanting to spend money on prescription medication.

Definitions: Functional vs. Total Recovery

The definition of a PD may also bear some consideration. In this study we have defined a PD as when a patient reported a 3 or higher on the diary measures. We may term this as a "functional recovery" because the subject may experience either no or a little problem with the particular measure, but it is assumed by our proposed definition of the PD that just a little problem should not interfere too greatly. However, from a patient's perspective, it may be worthwhile to know how long to expect until full recovery.

If we are to redefine a PD as a "total recovery", i.e. anything other than a 1 on the Likert-type scales, our results do change, especially in regards to opioid use. Particularly, when performing the same multifactorial analysis using a total recovery definition of a PD, then opioid use becomes significant as a main effect in both oral function ($p=.018$) and in daily activities ($p<.001$). Figure 8 shows the comparison between the oral function measures when comparing the functional and total recovery models, while Figure 9 demonstrates the differences between functional and total recovery for daily activities. Figure 10 demonstrates the mean medication use by the defined opioid use groups (Op7 and Op7+). This table summarizes the mean total number of days medication was used (NumMedDay), the mean total number of days opioids were used (NumOpDay) and the last day any type of medication was used (lastMedDay). While NumMedDay and NumOpDay are not consecutive, lastMedDay represents the day at which medication was no longer needed as reported by the patient.

The gap between functional and total recovery does not necessarily condemn functional recovery as useless. For example, returning to Kau, Cronin and Richmond,[70] those authors reported that by 3 months, the mean resolution of swelling in each of their patients was only 70%. Even when comparing this to our total resolution data, the mean number of PD in swelling in our cohort was only 49 days, slightly more than half of the 90 days in three months. This reflects some sort of gap between a patient reporting a PD and some swelling being measured by a laser soft tissue scan. Even though the PD are not consecutive, swelling tends decrease over time and should stay resolved, once resolved, barring infection or other complication. Therefore, we may be able to plausibly suggest that a patient is able to cope with "a little problem," i.e. functional recovery, rather than the defined functional recovery becoming an iatrogenically induced resolution.

VI. Conclusions

Age appeared to be the greatest determinant in the outcomes reported. Age was found to be a significant main effect in the multifactorial ANOVA analysis, and was part of a several significant interactions. Older patients may need more pain control in the form of opioid analgesics to be better prepared to cope with longer term sequelae; additionally, older patients who have two jaw surgery tend to experience more worst pain and average pain PD. Older patients will typically experience more long term sequelae PD than younger patients, based on the type of surgery. Younger patients seem to report a similar number of PD in oral function, whatever type of surgery may have occurred, but older maxilla only patients tend to fare better in oral function than when the mandible is involved. Involvement of the mandible in older patients tends to increase the number of PD in a number of measures which should be considered when presenting treatment options.

In addition, it may be recommended that because some patients may be using medication for total resolution purposes, and not just functional resolution, providers should be prepared to help patients make an appropriate transition from opioids to other analgesics. Additionally, some patients may need stronger analgesics longer than others, therefore an awareness of patient problems in some of the diary measures may allow providers to feel more comfortable with prescribing additional opioid analgesics.

Table 1

	N	%
Female	124	65.9
Male	64	34.1
Caucasian	155	82.4
Other	33	17.6
Maxilla only	71	37.8
Mandible only	48	25.5
Two Jaw	69	36.7

Cohort Descriptive Statistics

Table 2

DOMAINS	DIARY MEASURES	Mean	SEM
Oral Function	Eating	41.91	1.80
	Chewing	47.12	1.69
	Opening	39.16	1.83
Daily Activities	Sleeping	10.95	0.91
	Talking	18.04	1.00
	Daily Routine	18.32	1.15
	Social Activities	20.87	1.27
	Sports and Hobbies	32.59	1.63
Acute Post-surgery Sequelae	Bruising	5.01	0.46
	Bleeding	3.59	0.30
	Nausea	2.52	0.29
	Feeling Anxious	6.27	0.71
	Feeling Trapped	5.04	0.73
Long Term Post-surgery Sequelae	Swelling	16.38	1.03
	Bad Taste in Mouth	11.85	0.96
	Food collecting between teeth	19.37	1.34
	Food collecting in incisions	10.76	1.15
Discomfort	Worst Pain	22.28	1.47
	Average Pain	13.71	1.06

Domain Measure Means and Standard Error of the Mean (SEM)

Table 3

	Oral Function		Daily Activities		Discomfort	
Explanatory Variable	Wilks' Lambda	Sig.	Wilks' Lambda	Sig.	Wilks' Lambda	Sig.
Gender	.982	.373	.951	.128	.997	.788
Age	.977	.261	.918	.012	.992	.500
Surgery	.963	.379	.938	.361	.964	.175
Opioid Use	.957	.059	.941	.066	.967	.057
Interaction						
Gender and Age	.959	.065	.976	.540	.992	.486
Gender and Surgery	.947	.150	.919	.156	.978	.435
Gender and Opioid Use	.962	.081	.970	.403	.988	.355
Age and Surgery	.928	.047	.928	.231	.938	.025
Age and Opioid Use	.969	.150	.953	.142	.989	.374
Surgery and Opioid Use	.951	.195	.962	.759	.980	.477

Multifactorial Analysis of Oral Function, Daily Activities, and Discomfort

Table 4

	Acute Sequelae		Longer Term Sequelae	
Explanatory Variable	Wilks' Lambda	Sig.	Wilks' Lambda	Sig.
Gender	.902	.003	.951	.070
Age	.970	.392	.959	.131
Surgery	.908	.086	.889	.010
Opioid Use	.997	.994	.991	.832
Interaction				
Gender and Age	.982	.675	.991	.812
Gender and Surgery	.980	.970	.958	.503
Gender and Opioid Use	.965	.295	.974	.334
Age and Surgery	.944	.457	.895	.015
Age and Opioid Use	.969	.371	.941	.035
Surgery and Opioid Use	.948	.514	.927	.113

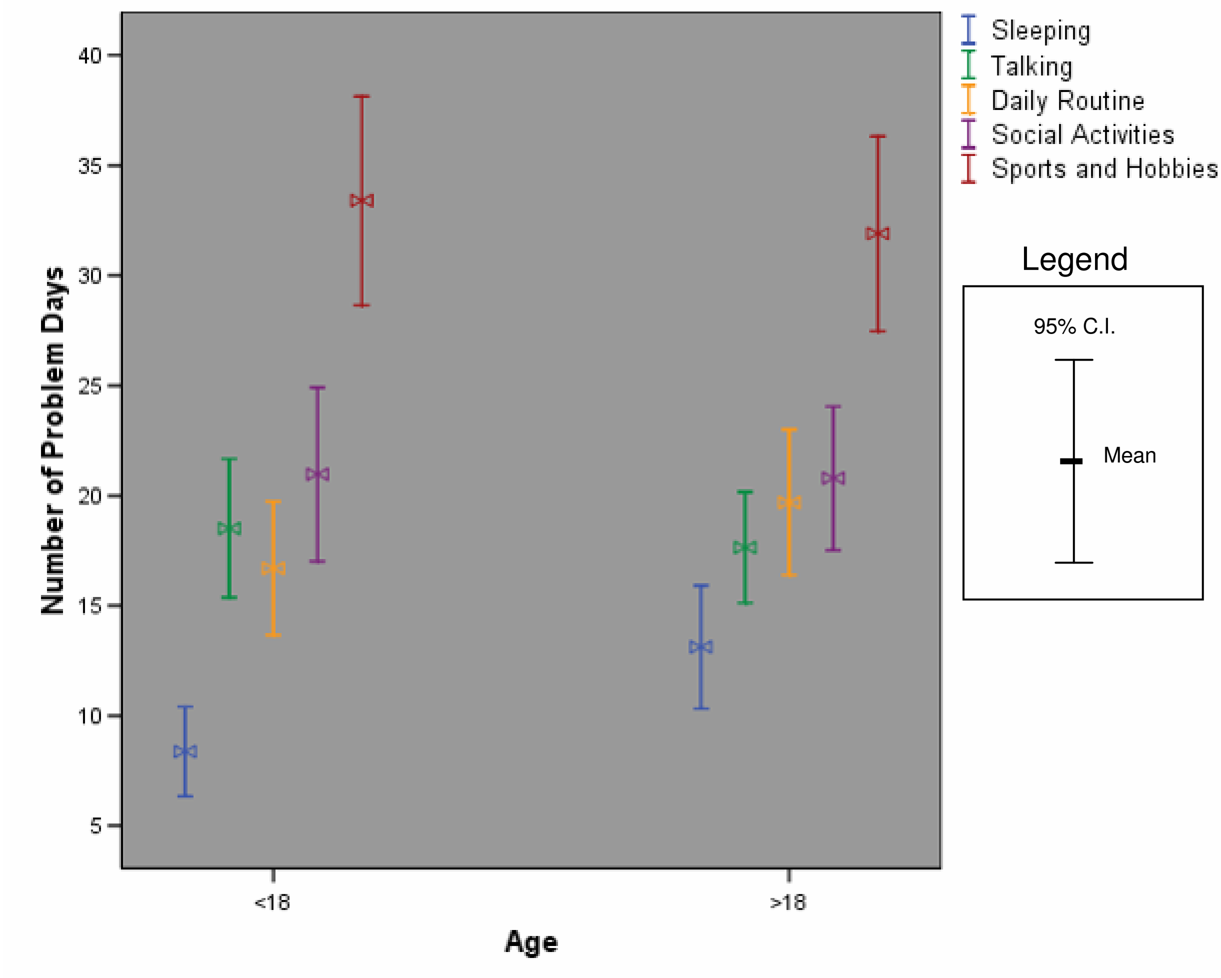
Multifactorial Analysis of Acute and Longer Term Post Surgical Sequelae

Table 5

DOMAINS	DIARY MEASURES	Corrected model Sig.
Oral Function	Eating	**.005**
	Chewing	**.041**
	Opening	**.001**
Daily Activities	Sleeping	**.003**
	Talking	.785
	Daily Routine	.206
	Social Activities	**.019**
	Sports and Hobbies	.293
Acute Post-surgery Sequelae	Bruising	.240
	Bleeding	**.013**
	Nausea	.615
	Feeling Anxious	.721
	Feeling Trapped	.357
Long Term Post-surgery Sequelae	Swelling	**.035**
	Bad Taste in Mouth	.210
	Food collecting between teeth	**<.001**
	Food collecting in incisions	**.008**
Discomfort	Worst Pain	**.037**
	Average Pain	.088

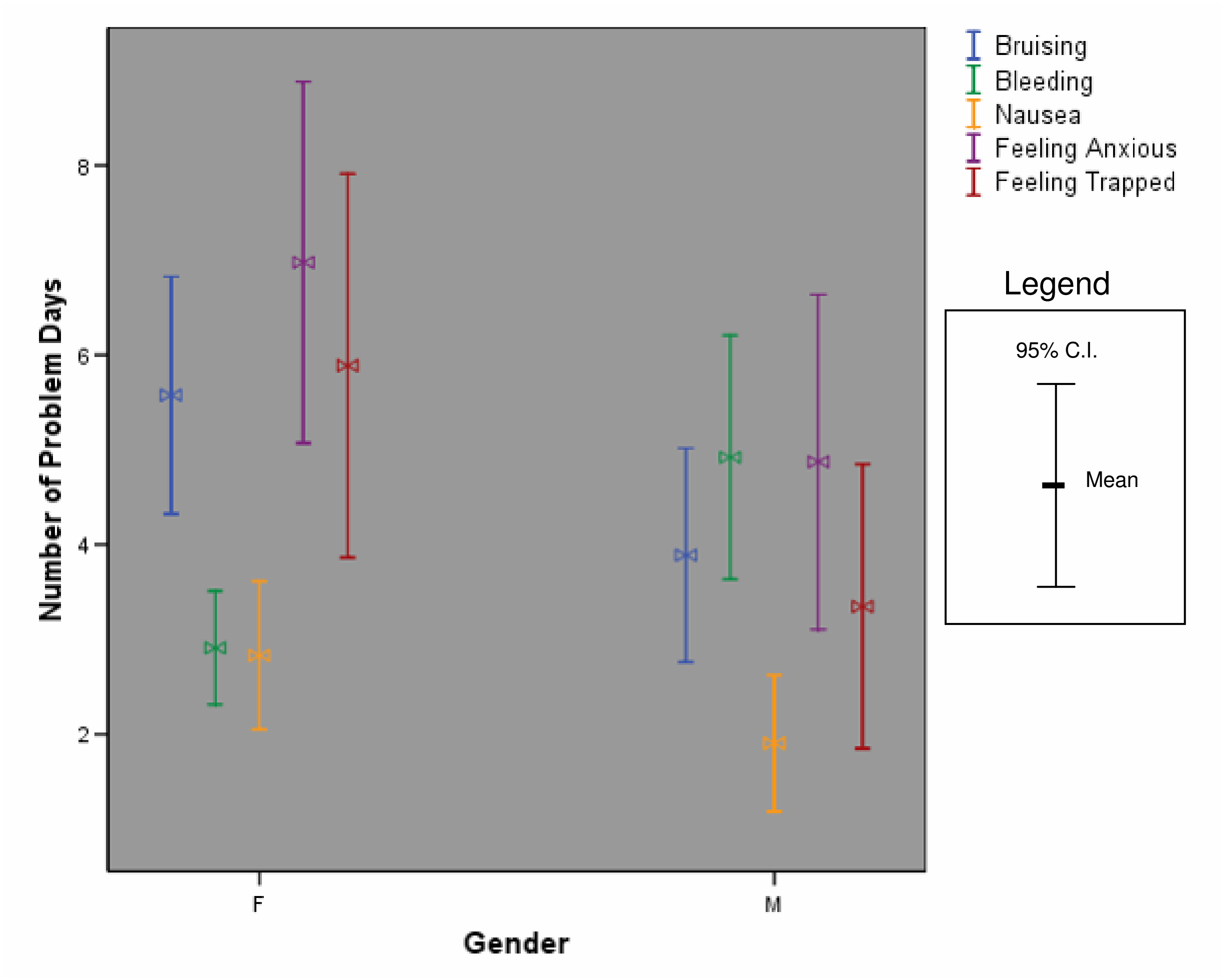
Corrected Model Significance

Figure 1



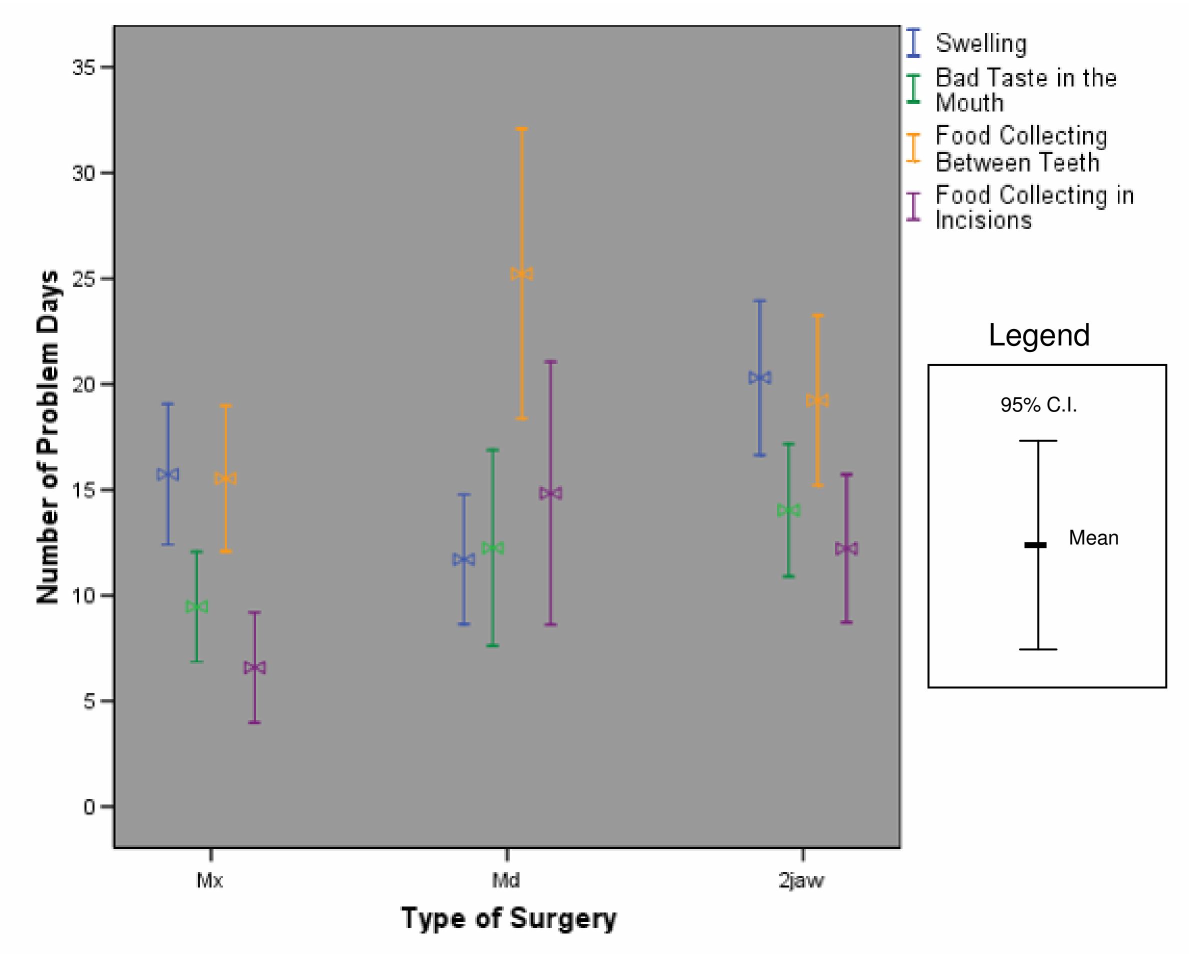
Problem Days for Daily Activities According to Age

Figure 2



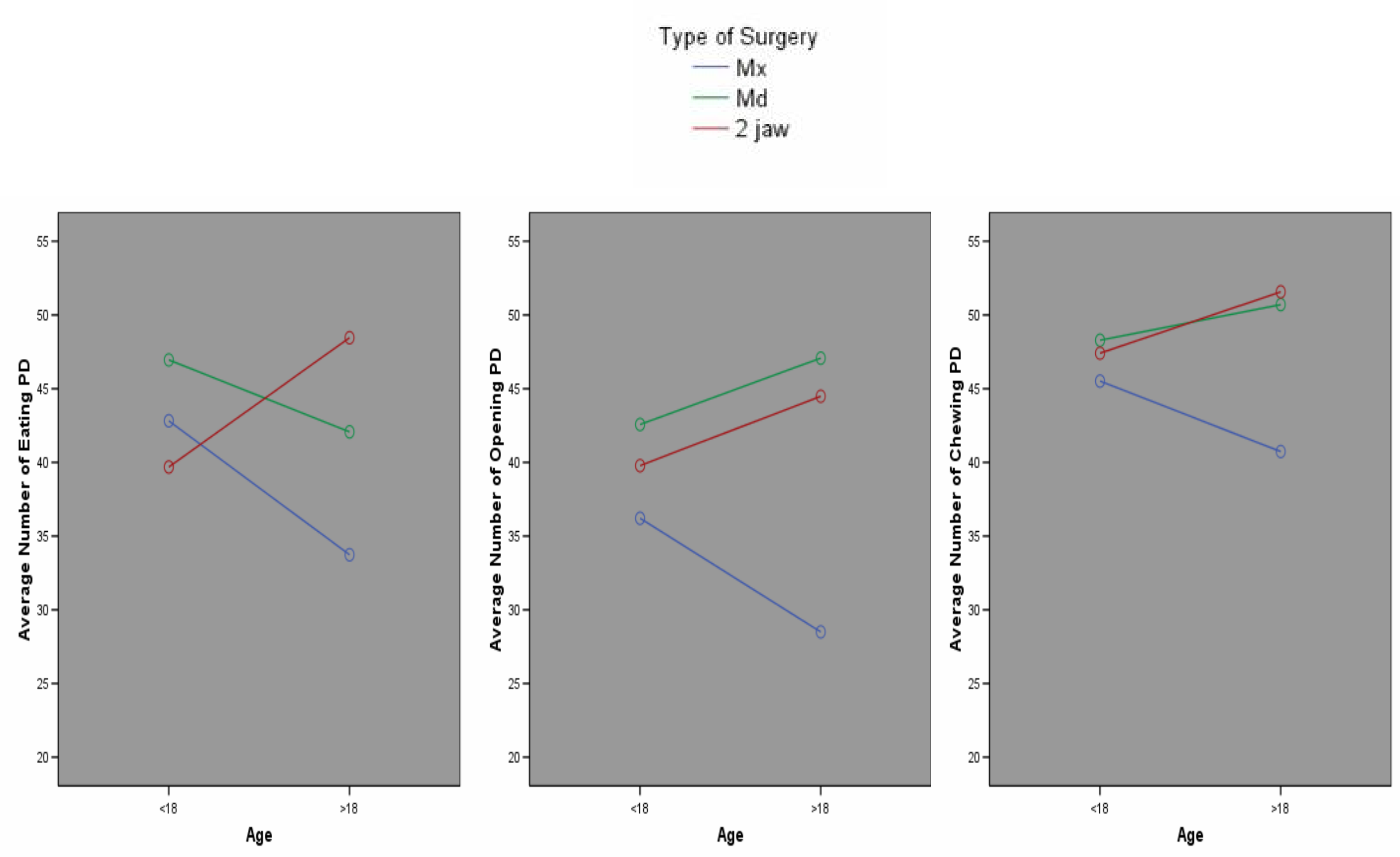
Problem Days for Acute Sequelae According to Gender

Figure 3



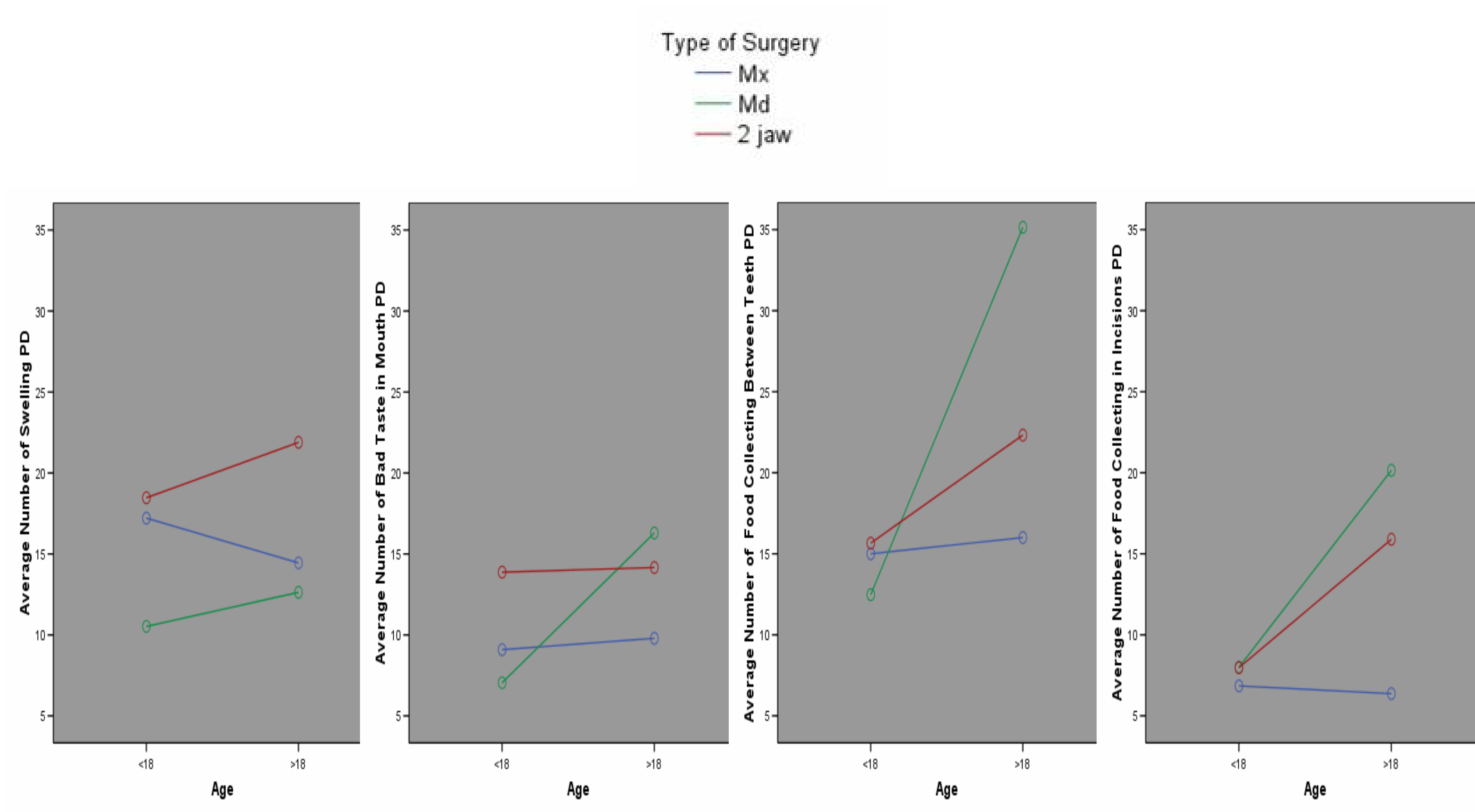
Problem Days for Longer Term Sequelae According to Type of Surgery

Figure 4



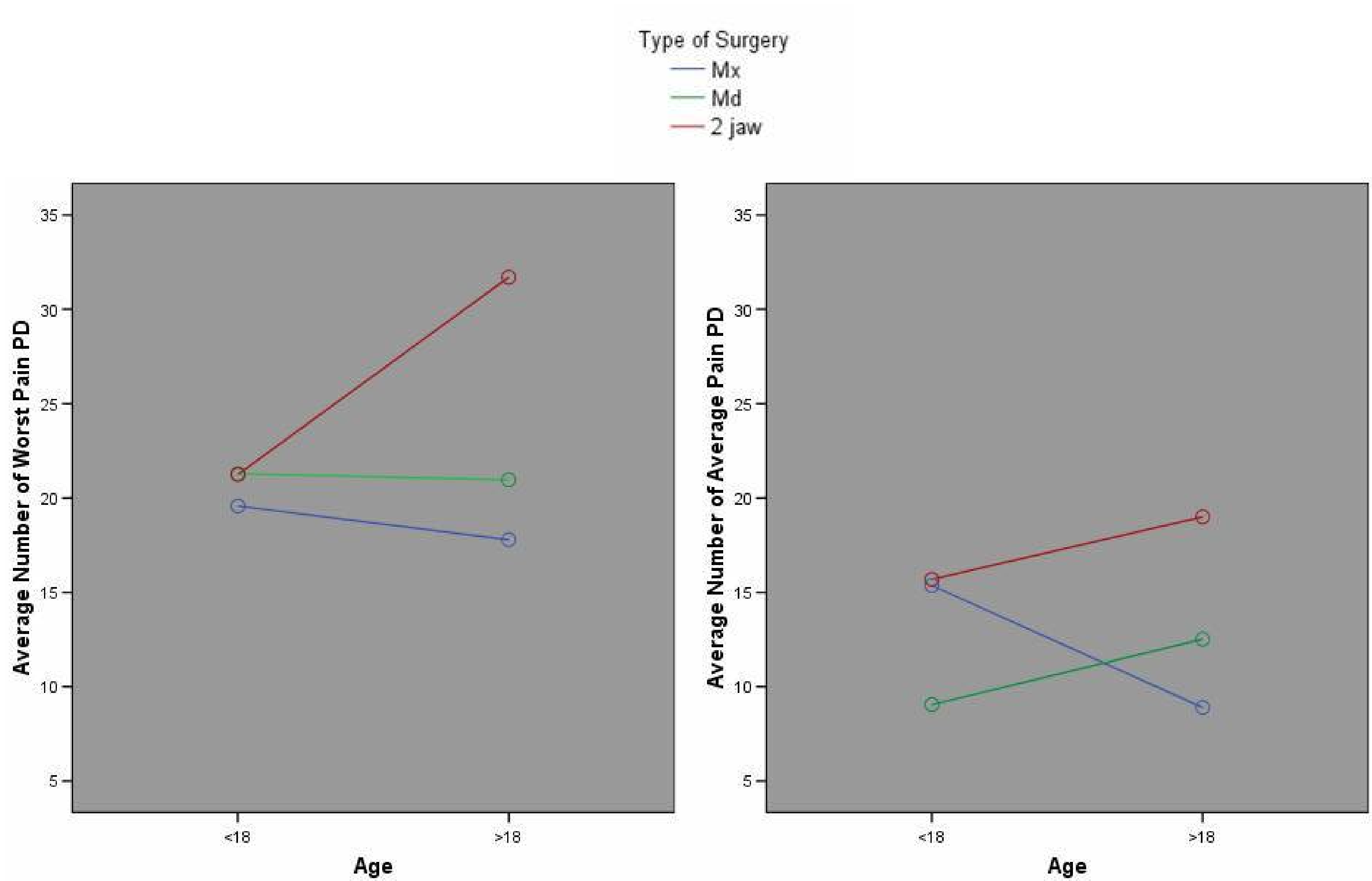
Interaction of Age and Type of Surgery on Oral Function

Figure 5



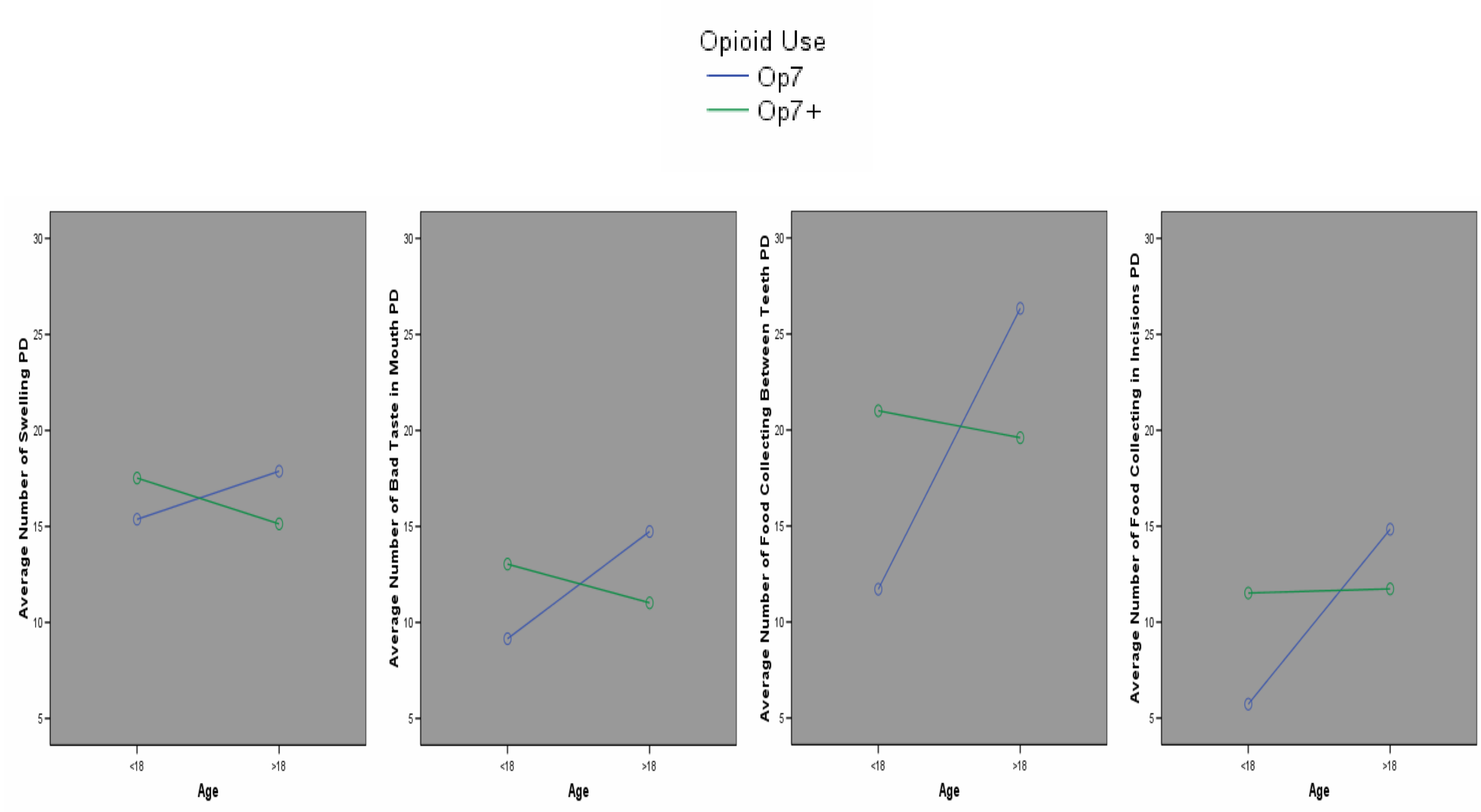
Interaction of Age and Type of Surgery on Longer Term Sequelae

Figure 6



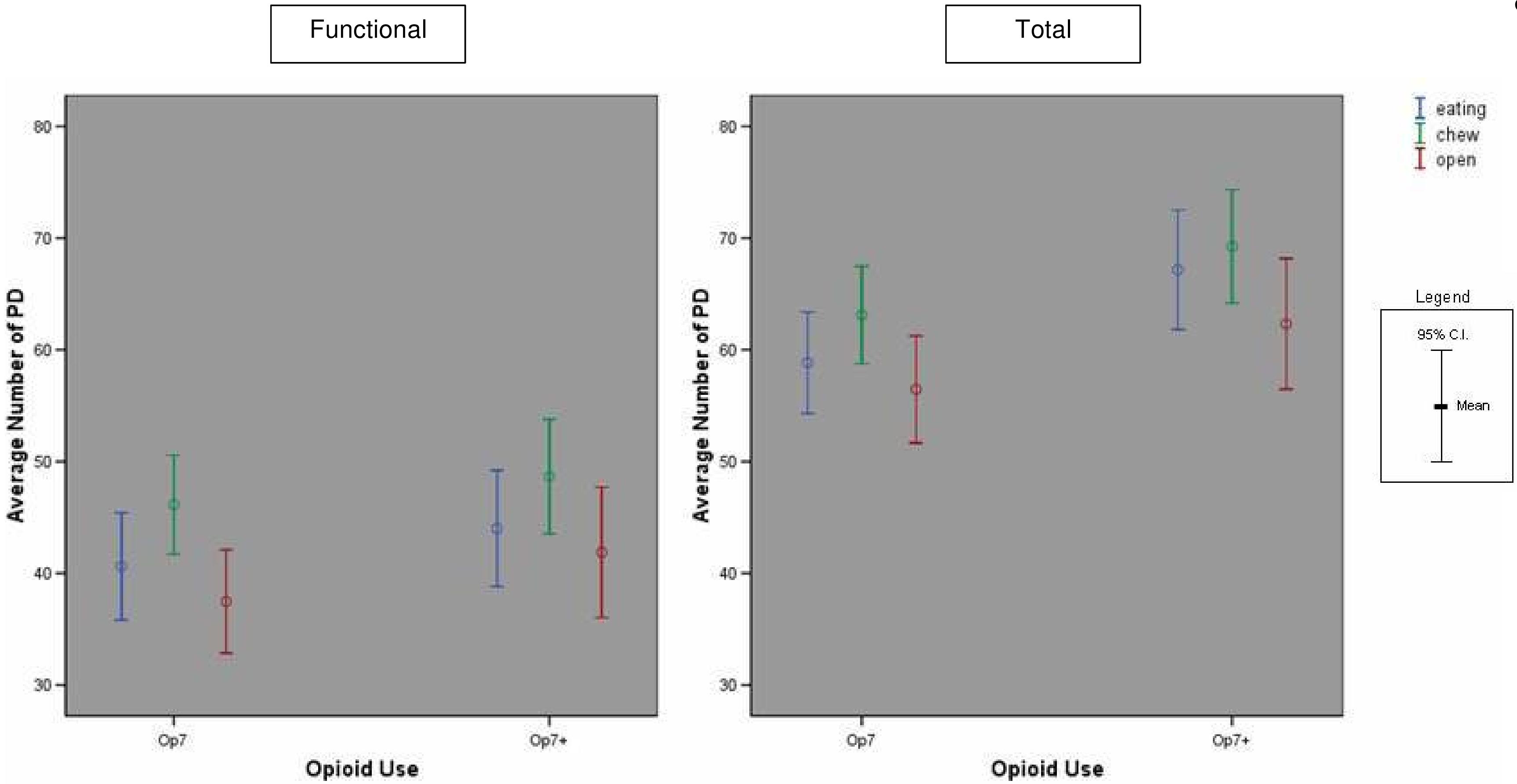
Interaction of Age and Type of Surgery on Discomfort

Figure 7



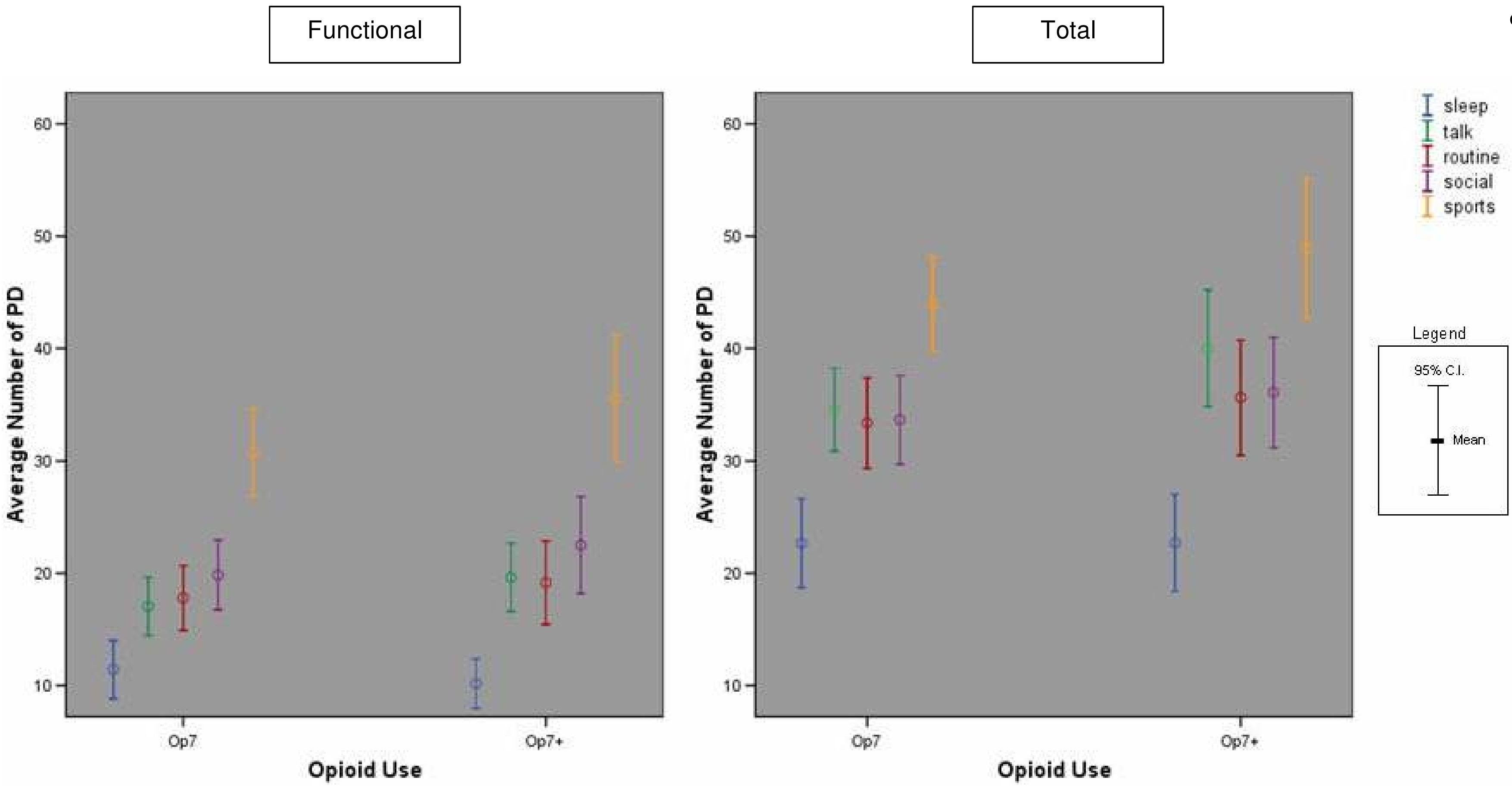
Interaction of Age and Opioid Use on Longer Term Sequelae

Figure 8



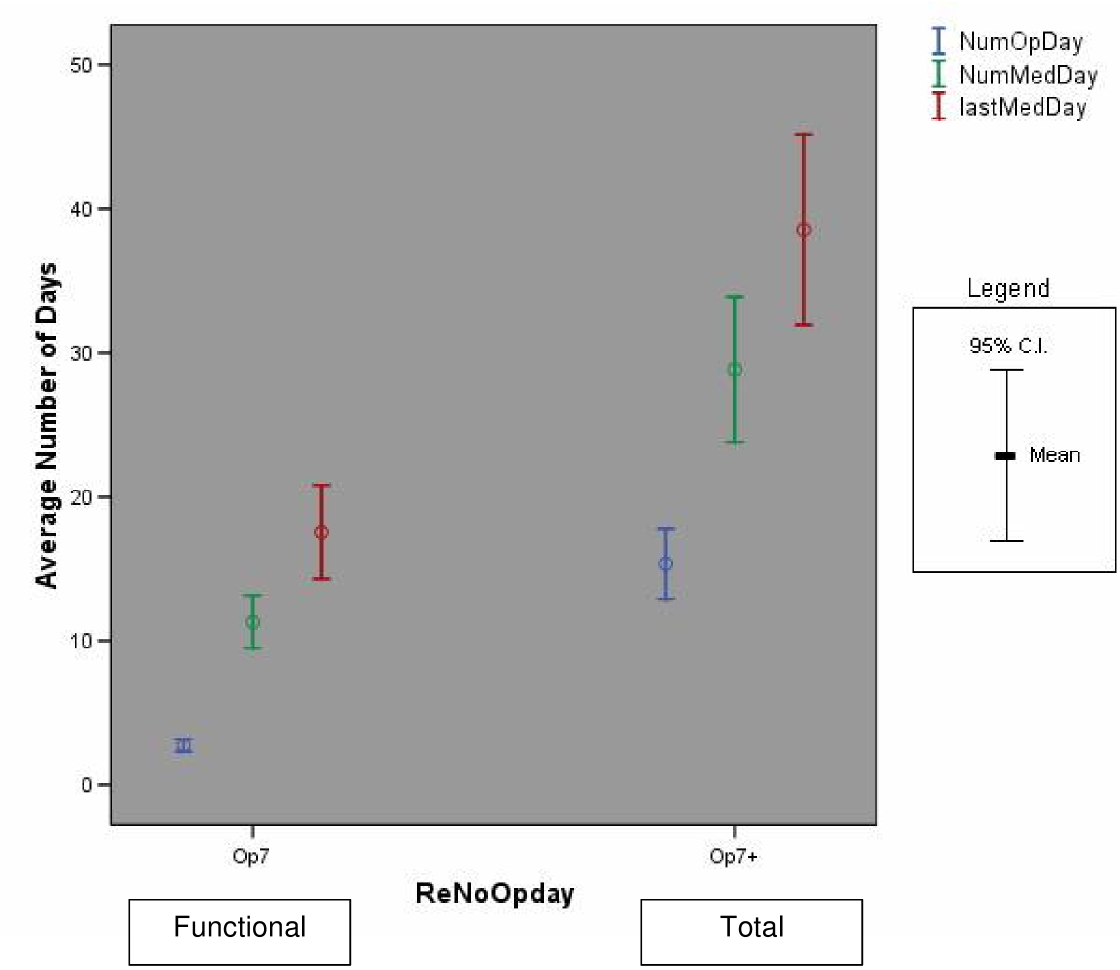
Functional vs. Total Recovery in Oral Function by Opioid Use

Figure 9



Functional vs. Total Recovery in Daily Activities by Opioid Use

Figure 10



Number of Medication Use Days by Opioid Use

NumOpDay = number of days opioids were used
NumMedDay = number of days any type of medication was used
lastMedDay = last day any type of medication was used

Appendix

UNIVERSITY OF NORTH CAROLINA
SCHOOL OF DENTISTRY
ORTHOGNATHIC SURGERY RECOVERY
DIARY

CASEBOOK: [redacted]

DAY: 0 7

Directions: **Completely fill in the ONE circle for each statement that best applies to you.**

A. PAST 24 HOURS

1. In the past 24 hours how much have your teeth or mouth given you trouble with:

	No trouble	A little trouble	Some trouble	Quite a bit of trouble	Lots of trouble
a. Eating the foods you want	○	○	●	○	○
b. Chewing foods easily	○	○	○	○	●
c. Opening your mouth as wide as you want	○	○	●	○	○
d. Sleeping	○	○	○	○	●
e. Talking so that people can understand you	○	○	○	●	○
f. Going about your everyday routine	○	○	○	○	●
g. Taking part in your regular social life	○	○	○	○	●
h. Taking part in your favorite sports / hobbies	○	○	○	○	●

2. In the past 24 hours how much trouble / concern has each of the following given you?

	No trouble	A little trouble	Some trouble	Quite a bit of trouble	Lots of trouble
a. Swelling of your cheeks	○	○	○	●	○
b. Bruising	○	●	○	○	○
c. Bleeding	○	●	○	○	○
d. Nausea	●	○	○	○	○
e. Bad taste / bad breath	○	●	○	○	○
f. Food collecting between or behind teeth	○	○	○	●	○
g. Food collecting at soft tissue incisions	○	○	○	●	○
h. Feeling anxious	●	○	○	○	○
j. Feeling trapped	●	○	○	○	○

	No discomfort						Worst discomfort imaginable
3. Rate the WORST discomfort you have felt in your teeth, mouth or face during the past 24 hours.	○	○	○	○	●	○	○
4. Rate the AVERAGE discomfort you have felt in your teeth, mouth or face during the past 24 hours.	○	○	○	○	●	○	○

5. Did you take any medication today to relieve pain or swelling? ● Yes ○ No

If yes, please write in the type of medication, the strength and the number of pills.

	Name of medication	Strength (such as # mgs)	Number of pills taken in last 24 hours
a.	Tylenol #3	150mg	5
b.	Ibuprofin	600 mg	4

Example of a Diary Page

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