

Chewing Gum Therapy in Third Molar Surgery

Dr S.D. Otto



UNIVERSITY *of the*
WESTERN CAPE

Chewing Gum Therapy in Third Molar Surgery

Abstract.

Purpose: The efficacy of a six-day chewing gum regimen in reducing pain, swelling and trismus after third molar surgery was compared to no chewing gum therapy.

Patients and Methods: Seventy patients needing removal of all four third molars were paired to be equal in their gender, age and degree of surgical difficulty. The pairs were numbered from 1 to 35. A flip of a coin determined which group would be the study group and which the control. All other aspects of the preoperative care, general anaesthesia, surgery and postoperative care were standardized for the groups. Pain, swelling and trismus were measured preoperatively and postoperatively after recovery and then on days 1, 3 and 5.

The study group followed a prescribed regimen of chewing sugarfree chewing gum. Chewing cycles of 10 minutes per 30 minute slot were prescribed and charted. On the day of surgery the aim was to achieve 10 cycles of charted chewing, commencing with discharge. Thereafter the aim was to achieve 20 cycles of charted chewing per day for the first 4 days postoperative and 10 cycles for the 5th day.

Results: No significant statistical difference was found between the groups in terms of pain and swelling. There was also no significant statistical difference between the groups for trismus on days 1 to 3 postoperative. A

significant statistical difference in degree of trismus between the groups was found on day 5.

Conclusion: Contrary to anecdotal reports from some surgeons, chewing gum therapy was found to have limited effectiveness in the management of minor complaints following third molar surgery.

Key words: third molar surgery, pain, swelling, trismus, chewing gum therapy, sugarfree gum.



Chewing Gum Therapy in Third Molar Surgery

Introduction

Third molar surgery is an important part of any maxillofacial surgery practice. There is an ongoing quest to find new and innovative methods to treat the minor complaints of this procedure. Well known to clinicians, these complaints are pain, swelling and trismus.

Some maxillofacial and oral surgeons use chewing gum therapy empirically and anecdotally after the removal of impacted third molars. These surgeons suggest that patients have less pain, swelling and trismus if they use chewing gum in a structured programme for a period of 5 days following surgery.

There are no documented studies in the literature to support the use of chewing gum therapy following third molar surgery. Thus the aim of this study was to compare the efficacy of chewing gum therapy with no therapy, using an observer blind, randomised study. Our null hypothesis was that chewing gum therapy would be superior to no therapy with regard to the common problems of pain, swelling and trismus following third molar surgery.

Literature review

Pain and trismus are some of the most frequent complaints following third molar surgery according to the work of Oikarinen in 1991 and Kim in 2006.

In addition, pain, trismus and swelling are closely associated with acute inflammation following third molar surgery as shown by Fisher in 1988.

Many modalities are available and have proved to be beneficial in the treatment of these minor complaints. These modalities include drugs, but are not limited to them.

Pharmacological management includes opiate and nonopiate analgesics. The nonopiate group includes acetaminophen and the non-steroidal anti-inflammatory drugs (NSAID). Acetaminophen is a good analgesic drug and is even more effective if it is combined with an opiate according to the work of Medve in 2001 and Macleod in 2002. Acetaminophen and a NSAID relieved pain equally according to the trial by Kubitzek in 2003. In 2006 Haglund, through his work, discovered that the combination of acetaminophen and a selective cyclooxygenase-2 (Cox 2) inhibitor has better analgesic effects than acetaminophen alone. Intravenous acetaminophen had a shorter time of onset than oral acetaminophen, according to the trial by Moller in 2005.

The use of steroids in third molar surgery has been extensively researched. Post operative methylprednisone reduces pain, swelling and trismus after third molar surgery, according to the trials by Esen in 1999, Holland in 1987 and Schultze-Mosgau in 1995. In 1993, Milles found that a low dose of

methyl prednisone the night prior to surgery and again after surgery, resulted in a significant reduction in post operative swelling. According to another publication by Baxendale in the same year, dexamethasone is effective in reducing pain and swelling following third molar surgery, but has a minimal effect on trismus. In the trial by Graziani in 2006, dexamethasone was found to be effective in reducing pain, swelling and trismus after third molar surgery.

NSAID's are used for inflammatory associated pain and has been researched extensively in this regard. Diclofenac reduced postoperative pain and swelling significantly according to the work of Henrikson in 1985. Lopez found that the effect of prednisone and diclofenac on trismus was very similar. Steroids and NSAID combinations prior to surgery are very effective in relieving post operative pain and swelling according to the trials by Lin in 1996, Moore in 2005 and Schultze-Mosgau in 1995.

Ordulu in 2006 found methyl prednisone as effective as placing a tube drain in the wound to reduce postoperative swelling. A tube drain was effective in reducing postoperative swelling, but had no influence on pain and trismus according to Cerqueira in 2004, Rakprasitkul in 1997 and Saglam in 2003.

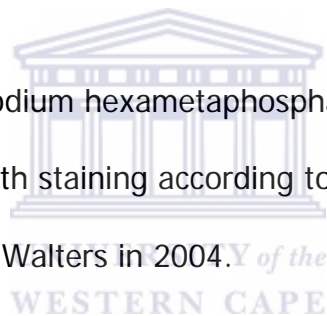
Postoperative pain and swelling were less severe with secondary healing than with primary healing (Pasqualini, 2005). Postoperative ice pack therapy did not significantly reduce pain, swelling and trismus according to the trial by

van der Westhuijzen *et al* in 2005. In the same year Rodrigues, found that postoperative cryotherapy reduced swelling and pain, but had no influence on trismus.

Literature supports the use of chewing gum for a variety of purposes.

Sucrose-free chewing gum has been used with success in preventing caries according to Barnes in 2005 and Szoke in 2005. Through their trials, Suda in 2006 and Twetman in 2003 found that Xylitol[®]-containing chewing gum increases remineralization of enamel defects and reduces subgingival plaque formation.

Chewing gum containing sodium hexametaphosphate reduces induced stain formation and prevents tooth staining according to the work by Biesbrock in 2004, Porciani in 2006 and Walters in 2004.



Wild found in 2001 that Sodium bicarbonate-containing chewing gum effectively reduces oral malodours. Chewing gum containing pyrophosphate and tripolyphosphate reduces supra gingival calculus formation according to the trails by Porciani in 2003. The use of Pycnogenol[®] chewing gums can minimize gingival bleeding and plaque accumulation (Kimbrough C, 2002).

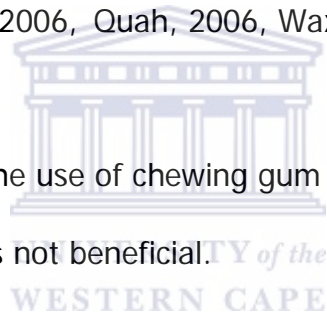
Chewing gum and artificial saliva could play an important role in the palliative care of patients with xerostomia associated with haemodialysis, according to Bots in 2005.

Chewing sugar free gum for half an hour after a meal reduces oesophageal reflux (Moazzez R, 2005).

Following a meal, calcium carbonate gum effectively neutralizes oesophageal acidity and relieves symptoms of reflux more effectively than antacid lozenges, according to Collings in 2002.

The use of postoperative chewing gum to shorten the period of postoperative ileus after bowel surgery, is well-supported by evidence (Asao, 2002, Hirayama in 2006, Matros, 2006, Quah, 2006, Waxman, 2006).

Hanif found in 1999 that the use of chewing gum as part of postoperative care after a tonsillectomy is not beneficial.



Gavish concluded in 2006 that an eight-week controlled chewing gum protocol causes an increase in electrical muscle activity and less pain in patients who suffer with myofascial pain dysfunction syndrome (MPDS).

Chewing gum containing nicotine is valuable in alleviating acute craving in smokers attempting to quit, according to Batra in 2005 and Shiffman in 2003.

To our knowledge no information is available on chewing gum therapy after third molar surgery.

Patients and methods

The University of the Western Cape (UWC) approved and registered the protocol with regard to content and ethics. Patients attending the Maxillo-Facial and Oral surgery out-patients clinic at the Faculty of Dentistry and World Health Organization (WHO) Collaborating Centre of UWC were selected according to the inclusion criteria of the approved protocol.

Healthy patients of all races, male and female between the ages of 18 and 28 requiring the removal of all four third molars under general anaesthesia, were included in the study. Patients with prior medical conditions that would contraindicate them to any of the planned interventions (general anaesthesia, surgery or postoperative care), were excluded. Mentally handicapped patients, habitual chewing gum chewers and pregnant or lactating female patients were also excluded. Only patients, who could express and record their data accurately, were included in the study.

All patients gave written informed consent to the procedure and to partaking in the study. Seventy patients were paired in terms of the degree of surgical difficulty (orthopantomographic evaluation), age and gender. These pairs were randomly divided into 2 groups. Patients who missed their initial scheduled surgery were paired again with patients on the trial waiting list.

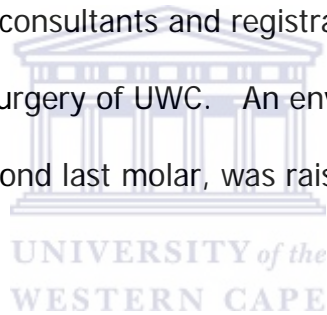
Anaesthetic management

An anaesthetist administered a standardized general anaesthesia.

Nasotracheal intubation was performed after intravenous induction with propofol, 2 mg/kg, and alcuronium, 0.3 mg/kg. General anaesthesia was maintained by isoflurane, nitrous oxide and 35% oxygen. Cardiac function was monitored with electrocardiography and the blood pressure was monitored by an upper arm cuff. Respiratory function was monitored by capnography and pulse oxymetry.

Surgery

Surgery was performed by consultants and registrars within the Department of Maxillo-Facial and Oral surgery of UWC. An envelope mucoperiosteal flap, buccal and distal to the second last molar, was raised exposing the third molar.



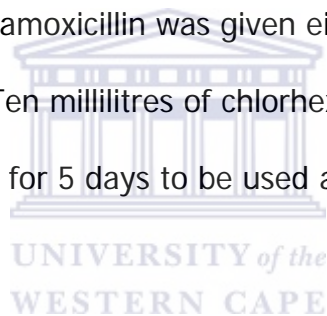
Bone was removed under constant sterile 0.9% saline irrigation, on the buccal and distal aspect of the third molar with a number 8 round surgical burr.

Tooth elevation, crown removal, root division and elevation were done as required. After removal of the tooth, the surgical field was meticulously rinsed with sterile 0.9% saline. The wound was closed by placing 3-0 chromic material as a continuous mattress suture.

No local anaesthesia or any local vasoconstrictors were used perioperatively.

Perioperative medication

Patients in both groups received the same pre and postoperative medication. Seventy-five milligrams of diclofenac was injected intra muscular at the time of induction. One thousand milligrams of paracetamol, eight hourly, was prescribed for pain for 2 days and started as soon as patients were awake. Four hundred milligrams of ibuprofen, six hourly, was prescribed for pain and swelling for 2 days and started as soon as patients were awake. Surgeons were contactable at all times if an escape drug was needed. We planned to give tilidine HCl as the escape oral opiate analgesic, but it was never needed. Five hundred milligrams of amoxicillin was given eight hourly for two days to prevent wound infection. Ten millilitres of chlorhexidine gluconate (0.2%) mouthwash was prescribed for 5 days to be used after meals.



Study design

All the patients were operated before 13h00.

Chewing charts on A4 sized paper were provided for each day. Ten minutes of charted chewing out of every half hour was selected for 5 hours before and after noon.

Three meal times per day were specified on the chewing chart. Patients in both the study and control groups were encouraged to take a soft diet for the duration of the study. From day 1 to day 4, patients thus chewed 20 cycles.

On the day of surgery, the aim was to achieve 10 cycles of chewing which commenced with discharge. On postoperative day 5, the aim was to achieve 10 cycles of chewing by 13h00, after which the last measurement was done. Chewing charts had to be ticked by the patient after completion of every cycle.

Wrigley's® Extra sugerfree chewing gum in peppermint and spearmint flavours as well as Wrigley's Orbit® classic chewing gum was selected to be used by the study group. This was provided by Wrigley's® and chosen due to its soft consistency.



Figure 1

Wrigley's® Extra sugerfree chewing gum

The most common minor complaints after surgical removal of impacted teeth namely pain, swelling and trismus, were measured.

Pain was recorded by the patients on a 100 mm standard visual analogue scale as suggested by Berge in 1988.

Many instruments exist and are effective in determining the exact degree of postoperative swelling. These include ultrasound, magnetic resonance imaging, stereotactografical measurement and the use of a hand held laser.

We used the measuring method described by Holland in 1979. This entailed using the bases of the external oblique ridges, bilaterally, as the point of maximal swelling. The measuring device was a standard face bow with a constructed central acrylic male socket. An occlusal splint made of silicone impression paste was combined with the female part of the face bow. This enabled us to reliably measure identical spots at each data collection.

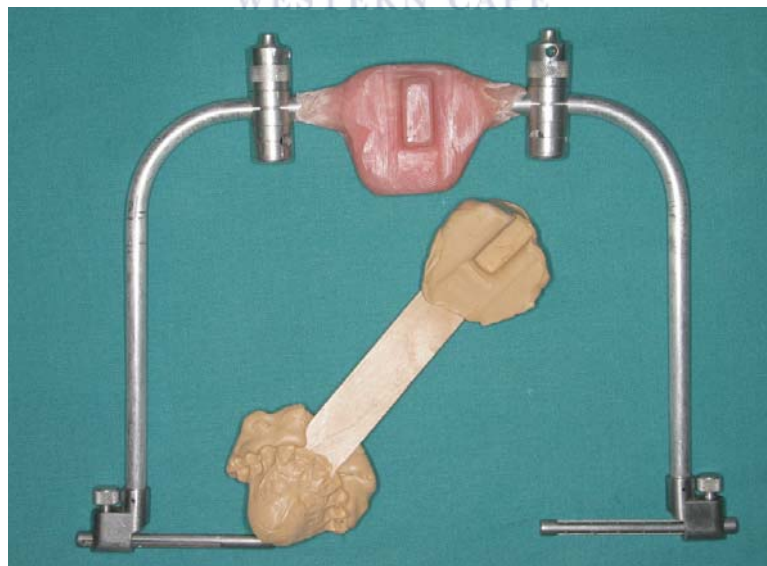


Figure 2

The facebow and occlusal splint

The maximum mouth opening (MMO) was measured preoperatively and postoperatively. The patient was asked to stretch the jaw for a few times and then the interincisal distance i.e. right upper and right lower central incisors, was measured with a vernier-calibrated sliding calliper. Postoperative data collection only commenced once patients were fully awake. Measurements were scheduled when minimum mouth opening was expected (maximum trismus) starting on day 1, day 3 and finally on day 5 at 13h00. Patients provided us with their completed chewing chart on day 5.

Statistical analysis was performed by the faculty statistician using the MS Excel and Number Cruncher Statistical System (NCSS) Software package.

Results

Graphic display of the treatment effect of chewing

An overview of the treatment effect according to the chewing treatment (Yes) and the control group (No) follows below.

Figure 3 displays the average pain scale on a 0 - 100 mm sliding scale where no pain equals 0 mm and the most severe pain equals 100 mm.

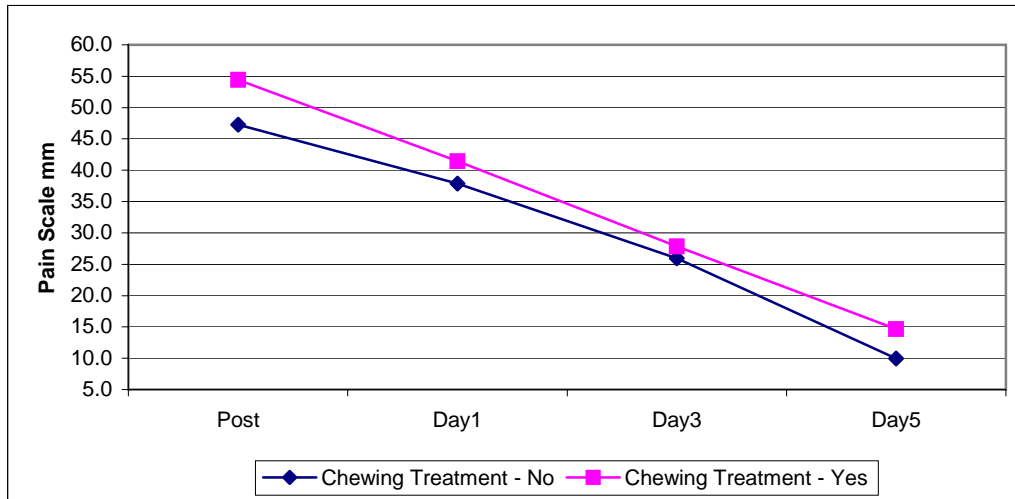


Figure 3

Average pain over post-treatment periods for both chewing (Yes) and non-chewing (No) groups

Measured pain abated from the first postoperative measurement to the final measurement on day five. Figure 3 shows that the non-chewing group experienced a slightly less pain than the chewing group. There was no significant statistical difference in pain measured between the two treatment groups. In addition there was no significant difference in the pain levels experienced between males and females.

Table 1

Pain experienced by the two treatment groups

		Post	Day 1	Day 3	Day 5
Chewing Treatment – No	Average of Pain	47.3	37.9	26.0	9.9
	Std Dev of Pain mm	23.89	28.03	21.52	11.71
Chewing Treatment – Yes	Average of Pain	54.4	41.5	27.9	14.7
	Std Dev of Pain mm	24.54	22.18	17.53	12.87

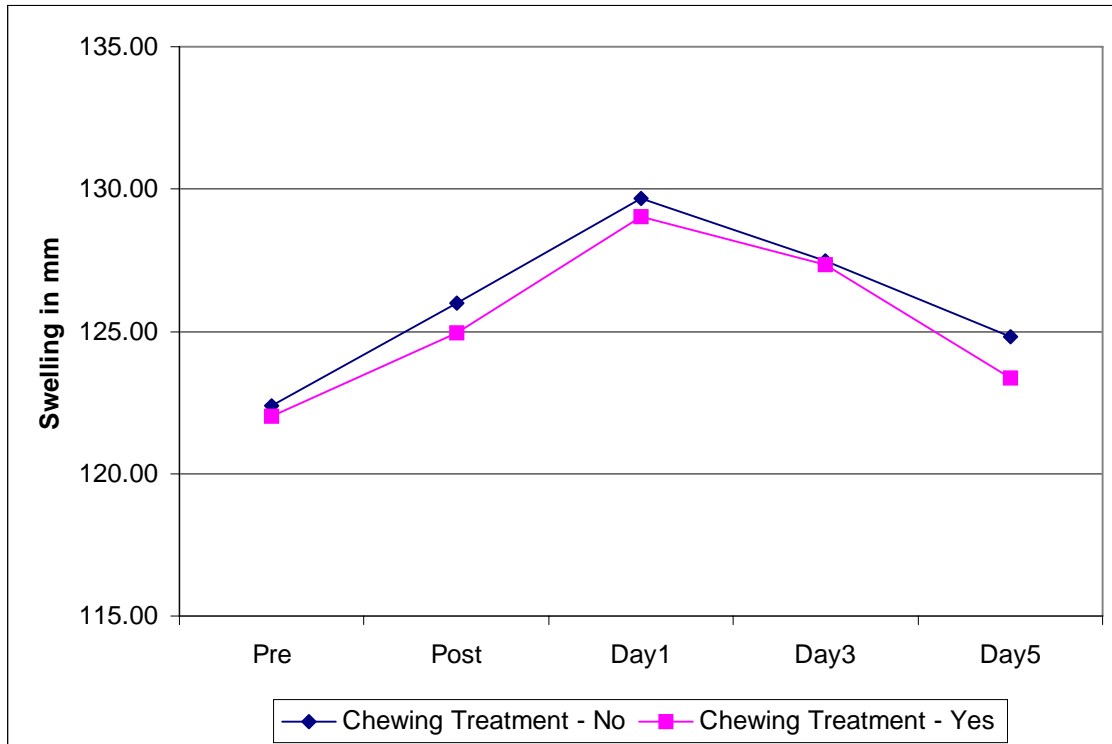
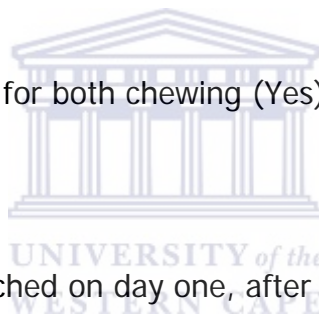


Figure 4

Average swelling over time for both chewing (Yes) and non-chewing (No) groups



Maximum swelling was reached on day one, after which swelling decreased steadily to day 5. The chewing group experienced, on average, less swelling than the non-chewing group at all measurement points, except on day 3 where the two averages approximately coincided.

Table 2 below documents the changes in swelling on a graph of the averages.

Table 2

The change in swelling with respect to the pre-recorded condition

Treatment Group	Descriptive Statistics	Swell Post-Pre	Swell Day 1-Pre	Swell Day 3-Pre	Swell Day 5-Pre
No-Chewing	Count	35	35	35	35
	Average of Chng Swell	3.6	7.3	5.1	2.5
	Std Dev of Chng Swell	4.53	6.09	5.25	3.82
Yes-Chewing	Count	35	35	35	35
	Average of Chng Swell	2.9	7.0	5.3	1.4
	Std Dev of Chng Swell	2.22	6.11	5.53	2.96

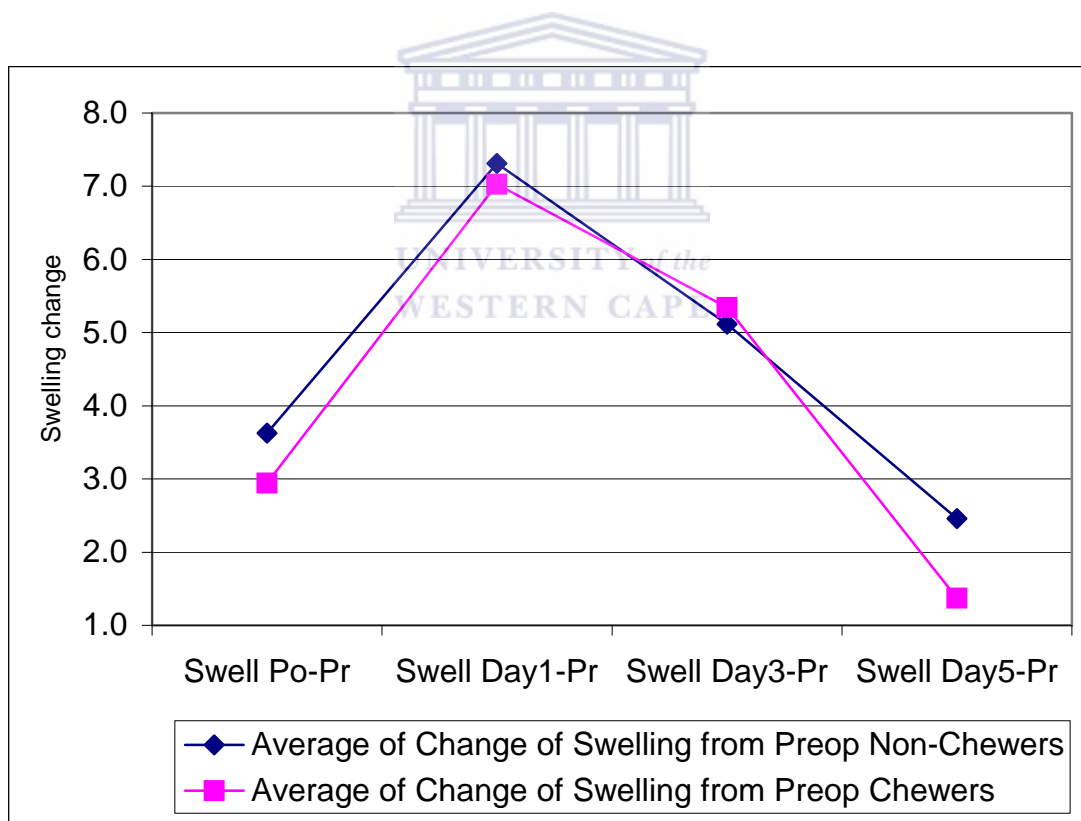


Figure 5

Average increase in swelling over post-treatment periods for both chewing (Yes) and non-chewing (No) groups

Figure 5 above gives an indication of the changes in swelling with respect to the baseline measurement. As was stated before, the swelling reached a maximum on day 1. None of the changes differed significantly different between the two treatment groups (see Table 3 below).

Table 3

Comparison of how the two treatment groups differ from each other when compensated with respect to the presurgical condition

Data	Swell Post-Pre	Swell Day 1-Pre	Swell Day 3-Pre	Swell Day 5-Pre
Significant or Not	Not Significant	Not Significant	Not Significant	Not Significant
p-value	—	—	—	—

In Figure 6 below, the average maximum preoperative mouth opening for both groups was approximately 43.6 mm. This maximum mouth opening decreased after the procedure as trismus set in. Trismus increased further on the first day when the maximum trismus was reached; thereafter it decreased slightly to day 3 and much more to day 5. On day 3 and day 5 the chewing group experienced on average less trismus than the non-chewing group.

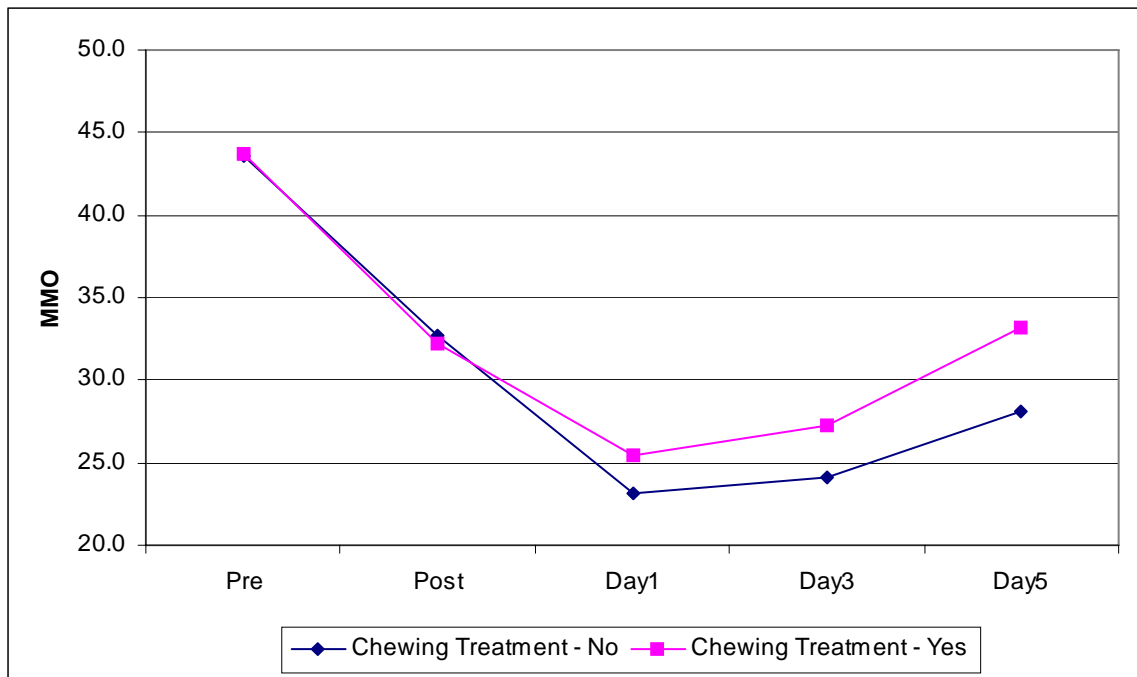


Figure 6

Average MMO over post treatment periods for both chewing (Yes) and non-chewing (No) groups.



Figure 6 displays the changes in the MMO with respect to the preoperative measurement. As in the previous graph the two treatment groups diverge towards day 5.

The pattern as seen in Figure 7 was confirmed by the table of descriptive statistics.

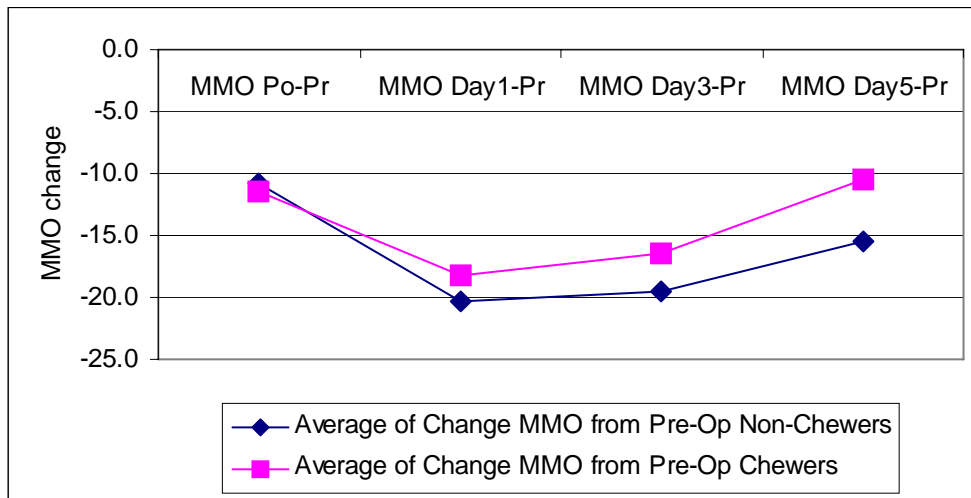


Figure 7

Average change in MMO over post treatment periods with respect to the pre-treatment MMO for both chewing (Yes) and non-chewing (No) group

The pattern as seen in Figure 5 was confirmed by the table of descriptive statistics below (Table 4).

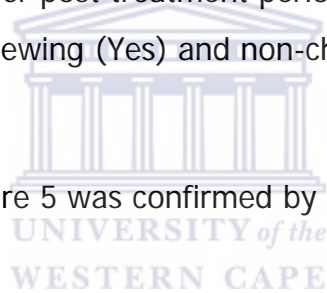


Table 4

The change in the MMO with respect to the preoperative measurement

Treatment Group	Descriptive Statistics	MMO Post-Pre	MMO Day 1-Pre	MMO Day 3-Pre	MMO Day 5-Pre
No Chewing	Count	35	35	35	35
	Average of Change	-10.9	-20.4	-19.5	-15.5
	Std Dev of Change	7.21	7.48	8.87	6.93
Yes Chewing	Count	35	35	35	35
	Average of Change	-11.4	-18.3	-16.4	-10.5
	StdDev of Change	7.99	6.34	6.43	6.30
Significant or Not	at the 5% level	Not significant	Not significant	Not significant	Significant
	p-value	—	0.081	0.060	0.003

Since the study was designed to investigate the effect of chewing, the control group obviously did not use any chewing gum. The graph below thus displays the average cycles of chewing for the chewing group only.

Table 5

Descriptive Statistics of chewing cycles over six periods

Data	Post-Op	Day 1	Day 2	Day 3	Day 4	Day 5
Count	35	35	35	35	35	35
Average	7.1	17.2	17.5	17.9	18.0	8.2
StdDev	2.43	1.74	2.02	1.80	1.72	1.82
Minimum	3	14	13	13	14	3
Maximum	10	20	20	20	20	10
Expected Number of Cycles	10	20	20	20	20	10
Proportion of Average of the expected Number of cycles (in %)	71%	86%	88%	90%	90%	82%

UNIVERSITY of the
WESTERN CAPE

As seen from the last percentages in table 5, it is clear that the average number of chewing cycles was always less than the prescribed target number of cycles. This percentage increased from the postoperative day up to day 4, but decreased slightly for day 5.

From the above findings it can be concluded that this unusual treatment had a positive influence on MMO. However, it was not very helpful with the alleviation of pain in the treatment group ($p > 0.05$). Treatment was equally unsuccessful with respect to swelling (it helped a little bit, but this was not statistically significant).

The subjects in the treatment group heeded the directions of the physician reasonably well based on an overall average of over 80% compliance. As was expected, compliance immediately postoperatively, was lower at an average of only 71%.

Report on possible differences between the baseline measurements compared to postoperative measures

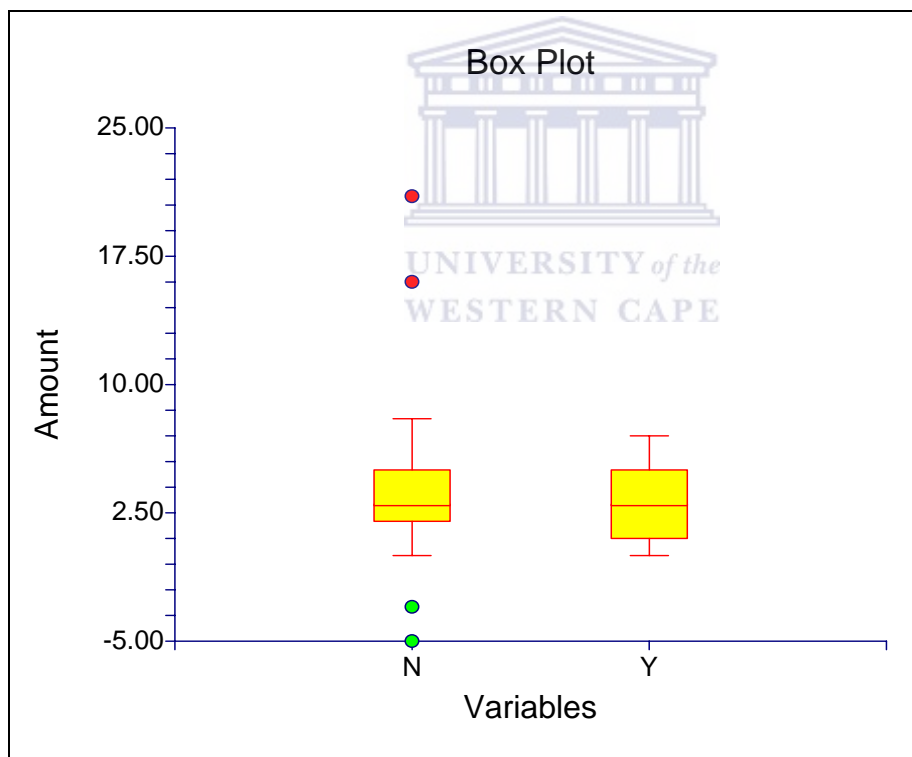


Figure 8

Box Plots of the changes between pre- and post-swelling measurements that occurred for the non-chewing (No) and the chewing (Yes) groups

The Median change for the two groups respectively was exactly the same (3 mm).

The non-chewing group provides evidence of positive differences and negative differences.

Table 6

Descriptive Statistics of the non-chewing group compared to the chewing group

Treatment Groups	Sample Size	Mean	Standard Deviation	Median
No	35	3.63	4.53	3
Yes	35	2.94	2.22	3

Table 6 shows that swelling occurred in both groups (see positive Means and Medians). The Mean change between the pre-swelling and the post swelling of the non-chewing group was 3.63 mm and that of the chewing group 2.94 mm, but the Median change of the two groups was equal to three (3 mm) for both groups.

Discussion

There are limited studies in the literature that deals with the effect of physiotherapy on post-operative pain and swelling. Jarit *et al*, for example suggested that according to their findings, home interferential therapy

resulted in significantly decreased swelling, an increased range of motion and decreased pain after knee surgery.

The common minor complaints following third molar surgery are pain, swelling and trismus (Berge, 1994, Kim, 2006, Oikarinen, 1991, Savin, 1997). For decades research has been done to find new ways to alleviate these complaints. According to Seymour in 1994, postoperative pain is a common phenomenon after surgery. This is due to surgical trauma and the release of pain mediators. Pain is the worst in the first 24 hours after surgery as Seymour found in 1985. Thus pain control should be the first and foremost aim of any post third molar surgery treatment.

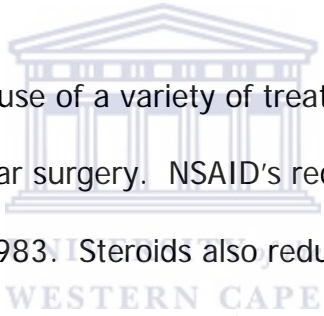
Many different modalities, of which some are pharmacological, have proven to be analgesic.



Acetaminophen is an important analgesic drug that has proven to be beneficial after third molar surgery, either alone or in combination with various other drugs. In combination, acetaminophen and NSAID's is a very effective analgesic (Kubitzek, 2003). Acetaminophen in combination with an opiate, is an extremely effective analgesic (Macleod, 2002 and Medve, 2001). NSAID's are proven analgesic drugs, alone or in combination with other drugs (Haglund, 2006).

Cyclooxygenase 2 (COX 2) inhibitory variants have advantages in terms of the known side effects. Perioperative steroid therapy reduces postoperative pain (Baxendale, 1993, Esen, 1999, Graziani, 2006, Holland, 1987, Schultze-Mosgau, 1995). Postoperative ice pack therapy does not reduce pain significantly (van der Westhuijzen, 2005).

Postoperative swelling is not as uncomfortable as postoperative pain, but it hampers patients in their daily activities. As corroborated by other researchers, we found swelling to reach a peak on day 1 post surgery. (Cerqueira, 2004)



The literature supports the use of a variety of treatment modalities to reduce swelling following third molar surgery. NSAID's reduce postoperative swelling as was found by Amin in 1983. Steroids also reduce postoperative swelling significantly (Baxendale, 1993, Esen, 1999, Graziani, 2006, Holland, 1987, Schultze-Mosgau, 1995). Ice pack therapy does not reduce postoperative swelling significantly (van der Westhuijzen, 2005). Placing a tube drain in the wound reduces the postsurgery swelling significantly. Trismus is reduced by steroids according to some studies (Esen, 1999, Holland, 1987, Schultze-Mosgau, 1995).

The aim of this study was to determine how effective a chewing gum regime is in treating the common minor complaints of third molar surgery. The results show that the co-operation of the patients was generally good, but the

prescribed number of cycles was never achieved. This was particularly true on the day of surgery. Although the acceptance of the regimen was not subjectively determined, it can be deduced that patients were generally reluctant to chew chewing gum immediately after surgery. Postoperative pain was the worst in the first 24 hours. Pain was generally slightly higher in the chewing group compared to the non-chewers. This difference was not statistically significant though. We do not know if pain was the reason for the slight apathy toward the chewing regimen. Patient acceptance could be included in a subsequent study.

Swelling was less in the chewers, but not significantly so. The results of this study suggest that trismus can be reduced by using a 5-day chewing gum regimen after third molar surgery. From the literature it is clear that trismus is only influenced by perioperative steroid therapy. Ten Bosch and Van Gool, found in their study in 1977 that patients still had significant problems with mouth opening on the fourth postoperative day. The morbidity of post third molar surgery trismus was not tested and could be investigated in a follow-up trial.

References

Amin MM, Laskin DM., 1983. Prophylactic use of indomethacin for prevention of post surgical complications after removal of impacted third molars. *Oral Surg*; 55 (5), 448-451.

Asao T, Kuwano H, Nakamura J, Morinaga N, Hirayama I, Ide M., 2002. Gum chewing enhances early recovery from postoperative ileus after laparoscopic colectomy. *J Am Coll Surg*, 195 (6), 901; author reply 901-2.

Barnes VM, Santarpia P, Richter R, Curtis J, Xu T., 2005. Clinical evaluation of the anti-plaque effect of a commercial chewing gum. *J Clin Dent*, 16 (1),1-5.

Batra A, Klingler K, Landfeldt B, Friederich HM, Westin A, Danielsson T., 2005. Smoking reduction treatment with 4-mg nicotine gum: a double-blind, randomized, placebo-controlled study. *Clin Pharmacol Ther*, 78 (6),689-696.

Baxendale BR, Vater M, Lavery KM., 1993. Dexamethasone reduces pain and swelling following extraction of third molar teeth. *Anaesthesia*, 48 (11), 961-964.

Berge TI., 1988. Visual analogue scale assessment of postoperative swelling. A study of clinical inflammatory variables subsequent to third-molar surgery. *Acta odontol Scan*, 46 (4), 233-244.

Berge TI, Boe OE., 1994. Predictor evaluation of postoperative morbidity after surgical removal of mandibular third molars. *Acta Odontol Scand*, 52 (3), 162-169

Biesbrock AR, Walters P, Bartizek RD., 2004 A chewing gum containing 7.5% sodium hexametaphosphate inhibits stain deposition compared with a placebo chewing gum. *Compend Contin Educ Dent*. 25 (4), 253-254.

Bots CP, Brand HS, Veerman EC, Valentijn-Benz M, Van Amerongen BM, Nieuw Amerongen AV, Valentijn RM, Vos PF, Bijlsma JA, Bezemer PD, ter Wee PM., 2005. The management of xerostomia in patients on haemodialysis: comparison of artificial saliva and chewing gum. *Palliat Med*, 19 (3), 202-207.

Cerqueira PR, Vasconcelos BC, Bessa-Nogueira RV., 2004. Comparative study of the effect of a tube drain in impacted lower third molar surgery. *J Oral Maxillofac Surg*, 62 (1), 57-61.

Collings KL, Rodriguez-Stanley S, Proskin HM, Robinson M, Miner PB Jr., 2002. Clinical effectiveness of a new antacid chewing gum on heartburn and oesophageal pH control. *Aliment Pharmacol Ther*, 16 (12), 2029-2035.

Esen E, Tasar F, Akhan O. Determination of the anti-inflammatory effects of methylprednisolone on the sequelae of third molar surgery. *J Oral Maxillofac Surg*, 57 (10), 1201-1206.

Fisher SE, Frame JW, Rout PGJ, McEntegart DJ., 1988. Factors affecting the onset and severity of pain following the surgical removal of unilateral impacted mandibular third molar teeth. *Br Dent J*, (164):351-354.

Gavish A, Winocur E, AstandzelovpNachmias T, Gazit E., 2006. Effect of controlled masticatory exercise on pain and muscle performance in myofacial pain patients: A pilot study. *Cranio*, 24 (3), 184-190.

Graziani F, D'Aiuto F, Arduino PG, Tonelli M, Gabriele M., 2006. Perioperative dexamethasone reduces post-surgical sequelae of wisdom tooth removal. A split-mouth randomized double-masked clinical trial. *Int J Oral Maxillofac Surg*, 35 (3), 241-246.

Haglund B, von Bultzingslowen I., 2006. Combining paracetamol with a selective cyclooxygenase-2 inhibitor for acute pain relief after third molar surgery: a randomized, double-blind, placebo-controlled study. *Eur J Oral Sci*, 114 (4), 293-301.

Hanif J, Frosh A., 1999. Effect of chewing gum on recovery after tonsillectomy. *Auris Nasus Larynx*, 26 (1), 65-68.

Henrikson PA, Thilander H, Wahlander LA., 1985. Voltaren as an analgesic after surgical removal of a lower wisdom tooth. *Int J Oral Surg*, 14 (4), 333-338.

Hirayama I, Suzuki M, Ide M, Asao T, Kuwano H., 2006. Gum-chewing stimulates bowel motility after surgery for colorectal cancer.

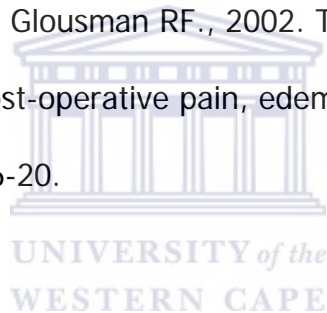
Hepatogastroenterology, 53 (68), 206-208.

Holland CS., 1979. The development of a method of assessing swelling following third molar surgery. *Br J Oral Surg*, 17 (2), 104-114.

Holland CS., 1987. The influence of methylprednisolone on post-operative swelling following oral surgery. *Br J Oral Maxillofac Surg*, 25 (4), 293-299.

Jarit GJ, Mohr KJ, Waller R, Glousman RF., 2002. The effects of home interferential therapy on post-operative pain, edema, and range of motion.

Clin J Sport Med, 13 (1), 16-20.



Kim JC, Choi SS, Wang SJ, Kim SG., 2006. Minor complications after mandibular third molar surgery: type, incidence, and possible prevention.

Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 102 (2), 4-11.

Kimbrough C, Chun M, dela Roca G, Lau BH., 2002. PYCNOGENOL chewing gum minimizes gingival bleeding and plaque formation. *Phytomedicine*, 9 (5), 410-413.

Kubitzeck F, Ziegler G, Gold MS, Liu JM, Ionescu E., 2003. Analgesic efficacy of low-dose diclofenac versus paracetamol and placebo in postoperative dental pain. *J Orofac Pain*, 17 (3), 237-244.

Lin TC, Lui MT, Chang RC, Zhonghua Yi,Xue Za Zhi., 1996. Premedication with diclofenac and prednisolone to prevent postoperative pain and swelling after third molar removal. *Zhonghua Yi Xue Za Zhi(Taipei)*, 58 (1), 40-44.

Lopez Carriches C, Martinez Gonzalez JM, Donado Rodriguez M., 2006. The use of methylprednisolone versus diclofenac in the treatment of inflammation and trismus after surgical removal of lower third molars. *Med Oral Patol Oral Cir Bucal*, 11 (5), 440-445.

Macleod AG, Ashford B, Voltz M, Williams B, Cramond T, Gorta L, Simpson JM., 2002. Paracetamol versus paracetamol-codeine in the treatment of postoperative dental pain: a randomized, double-blind, prospective trial. *Aust Dent J*, 47 (2), 147-151.

Matros E, Rocha F, Zinner M, Wang J, Ashley S, Breen E, Soybel D, Shoji B, Burgess A, Bleday R, Kuntz R, Whang E., 2006. Does gum chewing ameliorate postoperative ileus? Results of a prospective, randomized, placebo-controlled trial. *J Am Coll Surg*, 203 (3), 404-405.

Medve RA, Wang J., 2001. Tramadol and acetaminophen tablets for dental pain. *Anesth Prog*, 48 (3), 79-81.

Milles M, Desjardins PJ., 1993. The Reduction of postoperative facial swelling by low-dose methylprednisolone: an experimental study. *J Oral Maxillofac Surg*, 51 (9), 987-991.

Moazzez R, Bartlett D, Anggiansah A., 2005. The effect of chewing sugar-free gum on gastro-esophageal reflux. *J Dent Res*, 84 (11), 1062-1065.

Moller PL, Sindet-Pedersen S, Petersen CT, Juhl GI, Dillenschneider A, Skoglund LA., 2005. Onset of acetaminophen analgesia: comparison of oral and intravenous routes after third molar surgery. *Br J Anaesth*, 94 (5), 642-648.

Moore PA, Brar P, Smiga ER, Costello BJ., 2005. Preemptive rofecoxib and dexamethasone for prevention of pain and trismus following third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 99 (2), 1-7.

Oikarinen K, Rasanen A. Complications of third molar surgery among university students. *J Am Coll Health* 1991, 39 (6), 281-285.



Ordulu M, Aktas I, Yalcin S, Azak AN, Evlioglu G, Disci R, Emes Y., 2006. Comparative study of the effect of tube drainage versus methylprednisolone after third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 101(6), 96-100.

Pasqualini D, Cocero N, Castella A, Mela L, Bracco P., 2005. Primary and secondary closure of the surgical wound after removal of impacted mandibular third molars: a comparative study. *Int J Oral Maxillofac Surg*, 34 (1), 52-57.

Porciani PF, Grandini S., 2003. A six-week study to evaluate the anti-calculus efficacy of a chewing gum containing pyrophosphate and tripolyphosphate. *J Clin Dent*, 14 (1), 11-13.

Porciani PF, Grandini S, Perra C, Grandini R., 2006. Whitening effect by stain inhibition from a chewing gum with sodium hexametaphosphate in a controlled twelve-week single-blind trial. *J Clin Dent*, 17 (1), 14-16.

Quah HM, Samad A, Neathey AJ, Hay DJ, Maw A., 2006. Does gum chewing reduce postoperative ileus following open colectomy for left-sided colon and rectal cancer? A prospective randomized controlled trial. *Colorectal Dis*, 8 (1), 64-70.

Rakprasitkul S, Pairuchvej V., 1997. Mandibular third molar surgery with primary closure and tube drain. *Int J Oral Maxillofac Surg.*; 26 (3), 187-190.

Rodrigues J, Filho L, Dias de Oliveira e Silva E, Camargo IB, Gouveia FMV., 2005. The influence of cryotherapy on reduction of swelling, pain and trismus after third-molar extraction. 136 (4), 774-778

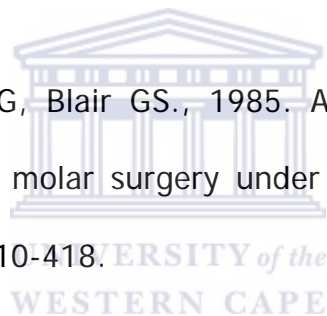
Saglam AA., 2003. Effects of tube drain with primary closure technique on postoperative trismus and swelling after removal of fully impacted mandibular third molars. *Quintessence Int*, 34 (2), 143-147.

Savin J, Ogden GR., 1997. Third molar surgery–A preliminary report on aspects affecting quality of life in the early postoperative period. *BrJ Oral Maxillofac Surg*, 35 (4), 246-253.

Schultze-Mosgau S, Schmelzeisen R, Frolich JC, Schmele H., 1995. Use of ibuprofen and methylprednisolone for the prevention of pain and swelling after removal of impacted third molars. *J Oral Maxillofac Surg*, 53 (1), 2-7.

Seymour RA, Walton JG., 1984. Pain control after third molar surgery. *Int J Oral Surg*, 13 (6), 477-485.

Seymour RA, Meechan JG, Blair GS., 1985. An investigation into post-operative pain after third molar surgery under local analgesia. *Br J Oral Maxillofac Surg*, 23 (6), 410-418.



Shiffman S, Shadel WG, Niaura R, Khayrallah MA, Jorenby DE, Ryan CF, Ferguson CL., 2003. Efficacy of acute administration of nicotine gum in relief of cue-provoked cigarette craving. *Psychopharmacology*, 166 (4), 343-350.

Suda R, Suzuki T, Takiguchi R, Egawa K, Sano T, Hasegawa K., 2006. The effect of adding calcium lactate to xylitol chewing gum on remineralization of enamel lesions. *Caries Res*, 40 (1), 43-46.

Szoke J, Banoczy J., 2005. Effect of after-meal sucrose-free gum-chewing on clinical caries. *SAD*, 60 (6), 248-251.

Ten Bosch JJ, Van Gool AV., 1977. The interrelation of postoperative complaints after removal of the mandibular third molar. *Int J Oral Surg*, 6 (1), 22-28.

Twetman S, Stecksén-Blicks C., 2003. Effect of xylitol-containing chewing gum on lactic acid production in dental plaque from caries active pre-school children. *Oral Health Prev Dent*, 1 (3), 195-199.

van der Westhuijzen AJ, Becker PJ, Morkel J, Roelofse JA., 2005. A randomized observer blind comparison of bilateral facial ice pack therapy with no ice therapy following third molar surgery. *Int J Oral Maxillofac Surg*, 34 (3), 281-286.

Walters PA, Biesbrock AR, Bartizek RD., 2004. Benefits of sodium hexametaphosphate-containing chewing gum for extrinsic stain inhibition. *J Dent Hyg*, 78 (4),8.

Waxman K, Schuster R, Grewal N, Greaney GC., 2006. Gum chewing reduces ileus after elective open sigmoid colectomy. *Arch Surg*, 141 (2):174-176.

Wild JE, Nelson BJ, Hubbard ME, Bowman J P., 2001. Oral malodor control afforded through the use of sodium bicarbonate-containing chewing gum. *Compend Contin Educ Dent*, 22 (7),43-46.

oo

