The timing of instructive information on postoperative course in third molar removal; effect on memory and pain perception

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SUMMARY
In oral and maxillofacial surgery, third molar (wisdom tooth) removal is a very common procedure. It is mostly performed under local anesthesia and patients are fully conscious and aware of surgery performed. In dental care, these procedures involving the mouth and oral cavity are considered to cause the most anxiety. For the postoperative recovery period patients are given information in the form of instructions involving wound care and what to do in certain situations to prevent complications.
Little is known how much the patient remembers of the information given, and if the timing of given instructions influences the amount that is remembered. Also, it is not clear if the information provided influences pain perception after the surgical procedure. This study is designed to investigate both.
Prospectively, a group of 105 patients were included and divided into three groups receiving instructions either in a consulting room minutes before surgery or directly after surgery, or in the operating room seconds before surgery. Ten specific information items were provided and evaluated. The results show that the mean memory score (M) of the standard group was significantly lower (on a scale of 0-100, M=72 ± 17) than in the groups receiving separate instructions before (M=81 ± 13) or after (M=89 ± 11) the surgical procedure. This may be due to a possible rise in anxiety just before surgery that may impair memory imprinting. The pain scores between the groups did not differ significantly. An explanation may be that our instructions were targeted at the wound care and complications, and not meant to lower anxiety, as anxiety can have an influence on postoperative pain.

SAMENVATTING
In de kaakchirurgie is het verwijderen van de derde molaar (verstandskies) een routine ingreep. De patiënt krijgt een lokale verdoving waarna de verstandskies wordt verwijderd. In de tandheelkunde zorgen deze ingrepen in de mondholte voor de meeste angst. Voor de postoperatieve herstelperiode, krijgen de patiënten informatie in de vorm van instructies aangaande wondverzorging en wat te doen in bepaalde situaties om complicaties te voorkomen. Het is niet bekend hoeveel informatie de patiënt daadwerkelijk onthoudt, en ook niet of het moment dat de informatie wordt gegeven invloed daarop heeft. Ook is niet bekend of de hoeveelheid informatie die onthouden wordt, invloed heeft op de pijnbeleving van de patiënt. Deze studie is ontworpen om beide te onderzoeken.
In deze prospectieve studie werd een groep van 105 patiënten geïncludeerd en verdeeld in drie groepen, die instructies kregen in een spreekkamer enkele minuten voor chirurgie of vlak na chirurgie, of in de operatiekamer vlak voor chirurgie. De resultaten laten zien dat de gemiddelde geheugenscore in de standaard groep significant lager (op een schaal van 0-100, M=72 ± 17) was dan in de groepen die apart instructies voor (M=81 ± 13), of na (M=89 ± 11) de chirurgische ingreep. Dit kan misschien verklaard worden door een spanningspiek bij de patiënt vlak voor chirurgie, die de geheugeninprenting kan verminderen. De pijnscores tussen de groepen verschilden niet significant. Een verklaring hiervoor kan zijn dat onze instructies waren gericht op wondverzorging en complicaties en niet om de angst te verlagen terwijl deze van invloed kan zijn op de postoperatieve pijn.

INTRODUCTION

Giving information before surgery (preoperative)

Thinking of quality in healthcare, providing information is not the first thing that comes to mind. Though, this also is a form of quality in healthcare. When a surgical procedure is performed it is important to provide information regarding the procedure, risks and complications. Furthermore, it is important to give instructive information regarding the expectancy on the effects and complications during the post-operative period. Not only is it necessary for obtaining informed consent, but it also prepares a patient on what to expect during the peri-operative period. The preparation of the patients on what they might expect regarding for instance pain, bleeding or swelling, seems to have an influence on the postoperative course, as many different studies have investigated.

One of the first and often cited author who studied how information can affect the patients' psychological stress and postoperative outcome, was Janis.[1] Because surgery is a threat to body integrity and can cause deprivations, the idea was that much could be learned from one's normal ability to adjust to life stress events. He conducted psychoanalysis on patients scheduled for major surgery. A relationship between the degree of fear preoperative and the degree of stress tolerance after surgery was observed. Janis noticed that giving preoperative information helps the patients to prepare themselves for the postoperative period and as a consequence prevents for negative reactions, such as anger and depression with various degrees of anxiety.

Postoperative pain

According to some studies [2-6] it may be useful to reduce preoperative anxiety, because preoperative anxiety levels seem to influence the postoperative outcomes such as pain. Investigators noticed a higher pain perception after surgery, correlated to a higher anxiety level. Several studies have proven that preoperative information is a powerful tool to reduce preoperative anxiety.[2,3,5,9] Egbert et al.[5] performed a study which investigated the role of instructions and encouragement and its effect on postoperative pain. This study reported that a group of patients receiving information about pain and postoperative recovery experienced less pain, required fewer analgesics and were discharged from the hospital earlier than the control group. An often cited study from Hayward[6] also concluded in their experimentally designed study that preoperative information reduces post-operative stress, pain and anxiety in general surgical patients.[6] However, other studies did not find a relationship between preoperative information and the effect on anxiety or pain.[7,8,9] One of these studies [9] provided a coping device which entails calming self-talk and cognitive control through selective attention to one group and information on the threatening event and reassurance regarding the event to another group, and both or nothing to another two groups. The coping device had significant influence on measured outcomes, including pre-surgical stress (lower) and the use of pain relieving medication (less). The information provided however, had no significant influence on any of postoperative outcomes, including anxiety. In another study[4] information was able to predict significant the amount of analgesics taken by the subjects. Anxiety did not have a significant influence. However, information nor anxiety could not predict the amount of pain experienced by the subjects.

A more recent study[7] suggests that information influences the experienced pain in patients scheduled for total knee arthroplasty surgery (surgical repair of the knee joint). The

postoperative pain seems to have a more rapid decline for the patients in the treatment group receiving the information. But no statistically significant differences were found to support these findings. The findings were based on assumptions made by deducting these assumptions from observations made for other purposes, and are open to other explanations. Nevertheless, the state anxiety, a method for scoring anxiety, before surgery was lower and the patients expressed more satisfaction with the postoperative pain management.
A Cochrane review from 2004 investigating the effect of preoperative preparatory information for hip replacement surgery on outcomes as postoperative pain, pre- and postoperative anxiety, did not find any significant results regarding pain.[8] They found evidence that preparatory information influenced the preoperative anxiety when compared to standard care. Some studies showed evidence that preparatory information was modest beneficial to preoperative anxiety, but not to postoperative anxiety. No differences were found in postoperative pain in the studies however.

From the studies mentioned above, though not all found significant results, one might assume that an influence of giving preoperative information on postoperative outcomes as anxiety and pain exists.

What do patients want to know?

Is there a need from the patient to obtain all this information? To provide information, to tell the patient what is to be done to him was considered common courtesy from early on.[10] There have been studies from early on, regarding the information needs and the patient´s wishes and expectations when it comes to information. Early hospital care research perusal by different authors clearly showed that communication difficulties, and more specifically, lack of information was a major complaint as studied by Barnes, who investigated psychological problems of general hospital patients, in the early 1960's[11].
Raphaels' [12] in a King Edward Fund study of patient satisfaction in the late 1960's, clearly exposed this problem. Since then many studies have been performed to encounter the problem of lack of information in various ways and identified various complaints and wishes of patients regarding providing information. The authors of a study group investigated the patients' need for pre-and postoperative information.[13] They investigated fifty patients scheduled for a cholecystectomy (removal of the gallbladder). They found that patients want a lot of information, on admission as well on discharge. The most requested information was related to anxiety-creating factors such as pain and post-operative symptoms after surgery.

According to a review from 2006 [14], the three major areas of informational needs were pain management, incision/ wound care and activity guidelines. Not only is this important for patients'satisfaction, but is also of great importance to prevent postsurgical infections, other complications or unnecessary visits to the hospital with anxiety or fear due to ignorance.[15-17] Patients who are not adequately informed or educated about pain management may return to the hospital for additional care, thus increasing the cost of care.[17] In addition, additional care increases anxiety and stress for patient as well for the caretaker.

Patients benefit of the knowledge of the degree and duration of pain after surgery, and the effective use of pain relieving measures.[15]The area of wound care, though very important, was an unmet need. This was exposed by a study in which two-third of the patients were identified to have a sternal wound infection following cardiac surgery after discharge.[16] Surgery site infection have been associated with mental health decline, increased visits to outpatient clinics and emergency department, increased radiology study and increased

utilization of homecare.[18] These studies suggest there is a need and necessity for the patient to obtain information regarding their surgery, thereby justifying further research in this area.

Mentioned studies mostly investigate surgeries performed under general anesthesia. But what about the necessity of information in the field of oral and maxillofacial surgery? Although common procedures as third molar, root canal treatment, or implant surgery are rarely life threatening and recovery period is not that long, it is often a stressful event for the patient as the procedure is performed mostly under local anesthesia and patients are fully conscious and aware of the actual surgery in progress. Several studies concluded that treatments associated with different aspects of oral surgery causes the highest anxiety levels in patients when it comes to dental care.[18-20] The fear or anxiety towards dental procedures is partially explained by early negative experience, which is probably the most stated cause for dental anxiety.[21,22]

It is also explained by the perception of dental context as uncontrollable and unpredictable that were considered important in fear acquisition[23] Anxiety levels seem to be related to the patients' perceptions of the likelihood of negative events. These anxiety levels correlate to the fear of pain and leaves patients who respond fearfully to pain at an increased risk of ending up in a vicious circle of anxiety, fear of pain, and eventually avoidance of dental treatment.[22] As it is of importance for a patient to comply to information about the postoperative course, it is of importance that any verbal provided information is remembered. One of the factors to negatively influence the ability to remember information, is stress or anxiety. Multiple studies show that fear levels significantly rise immediately before dental surgery.[20,24] Stress significantly reduces one's cognitive ability to process information.[24,25] Schwartz et al[25] stated that in a stressful pre-surgical setting the ability to process information is severely impaired and therefore information should not be given immediately before surgery. In a 2003 performed meta analysis regarding stress, glucocorticoids and memory, that included some 1642 participants derived from 28 studies, they found a correlation between high cortisol levels and memory decline.[26] Thus, if assumed that information has an effect on the state anxiety and therefore pain levels measured postoperative, then it is of importance that the information provided is remembered by those who receive it. When a patient is able to reproduce the information that is provided, one knows the information has been transferred correctly and information in that way is most profitable when it comes to the positive influence on postoperative outcomes.

Zanatta et al[27] performed a study that included 112 patients scheduled for third molar extraction. Patients were randomly appointed to an experimental group that received face to face information, or a control group not receiving that face to face information. Pain measurement was conducted at five moments from immediate after surgery until the moment the sutures were removed. In all these various moments, a significantly lower pain sensation was reported in the face to face information group.

There have been studies that have investigated the amount of information a patient can remember. Shukra et al.[29] conducted a study, with hundred patients included, which investigated what these patients remember best when given information to obtain informed consent. Different strategies were tested to provide information using verbal, written and videotaped information. Concluded was that supplementing the verbal explanation with a simple brochure or video images, leaded to a significant better memory imprinting.

Timing of given information

Many of the mentioned studies have provided the information before surgery. Little is known about the timing of giving this information about the postoperative course. There are implications that information about the postoperative course have a significant influence on patients wellbeing or health, and have economical benefits.[15-17] Vallerand et al[28] concluded that postoperative preparatory information significantly reduces the pain in the early period after third molar extraction. Patients that received information about the postoperative course experienced significantly less pain during the period from 12 - 24 hours postoperatively and patient satisfaction with pain control was significantly greater in the treatment group. According to some studies stress is at a peak and memory imprinting is impaired just before surgery.[20,26] So when is it the best timing to provide these instructions? There are studies regarding the timing of providing preoperative information on postoperative outcomes.[30,31] These studies suggest that the appropriate timing of providing this information remains unclear as they implicate there is little difference whether patients receive information up to a week or ten days before surgery, the day before surgery or even very short (hours) before surgery, and after surgery. However, these studies did not investigate the differences if the instructive information on postoperative course are provided just moments before surgery, as is often the case when a third molar removal is performed. One study on patients compliance to information about the postoperative course after oral surgery support [32] found that 40% of the included patients did not remember receiving both written and verbal instructions. Of the subjects, 36% remembered only the written instructions. The poor recollection of the verbal instructions can be explained by the patients' stress before surgery. Conclusion of the study was that both written and verbal explanation about postoperative swelling and pain are important for achieving a successful postoperative recovery.

In the outpatient depart of the Department of Oral and Maxillofacial Surgery of the Scheper ziekenhuis in Emmen, the Netherlands, instructions to patients in whom wisdom teeth have to be removed are routinely given in the operating room, very short before the actual surgery. With evidence that patient anxiety is at a peak just before surgery and memory maybe impaired, combined with the fact that adequate information can have a positive influence on postoperative recovery, it was felt by the surgeons that the current method to provide instructive information on postoperative course to the patients was susceptible for improvement. As the effect of timing of postoperative information was not known, it was decided to prospectively assess the effect of timing the information to the patient needed for the postoperative trajectory with regard to:

1) the effect of timing the information on the amount of information that is memorized;
2) the effect of timing the information on the amount of anxiety and postoperative pain experience

PATIENTS AND MATERIALS

Location

This study was performed and executed in patients referred for removal of wisdom teeth to the department of oral and maxillofacial surgery of the Scheper hospital, Emmen, the Netherlands.

Patients

All included patients were scheduled for removal of the mandibular (lower jaw) third molar. Thirty-six patients had additionally their maxillar (upper jaw) third molar extracted (34.3%). Inclusion criteria for these patients were:

Patients indicated to have a lower third molar extraction
Aged between 16 en 65 years
No recent third molar removal

Exclusion criteria were:

Mentally retarded
Recent third molar removal < 1year
Not in age interval
Not mastered sufficient the Dutch language

The patients were asked to participate by the assistant as they made an appointment, or they were asked by phone if they were already scheduled for surgery. The latter was the case of majority of all included patients. The surgery was performed under local anesthesia and was performed by three different, licensed oral and maxillofacial surgeons. Informed consent was obtained from all patients prior to the study. The patients were only asked to participate in a study about pain after the removal of a third molar, and that they would be instructed by the investigator. Explicit care was taken not to mention that we would evaluate the amount of instructions remembered, since this knowledge may influence memory function. No other interventions, medical treatments or information were given to participating patients in comparison to regular patients. The medical ethical commission (METc) in the Scheper hospital concluded that no formal consent was necessary for this study.

Instructions

The instructive information included ten instructions, extracted from a brochure which is given to all patients scheduled for surgical third molar removal. This brochure contains perioperative information and information about the postoperative course regarding third molar removal (all patients received this brochure as they went home after the surgical procedure and the participation to this study). The instructions were all given verbally. With these instructions an explanation was given why this instruction is important. This way the patients understand better the reason why they have to comply to these instructions, and the anticipation is that they will remember easier these instructions. The following instructions were given:

1. *Bite on gauze for 20 minute; necessary to form a blood clot that stops the bleeding*
2. *Local anesthesia is effective 2-4 hours; take an analgesic before the effect of the local anesthesia has declined; this way the patient has the least chance of experiencing pain*
3. *Do not rinse for 24 hours; this way the blood clot is kept in place. By rinsing one can remove the blood clot and cause a bleeding*
4. *Stitches will disappear in 7-14 days*
5. *A swelling may occur; this swelling can increase in size up to the third day, after that it has to decline. If not; one should call the surgeon*
6. *By cooling this swelling, one can counteract this swelling*
7. *It is ok to brush teeth, but one must be careful in proximity of the wound because of the stitches*
8. *One can eat and drink. Be careful with hot tea or coffee or eating things when the local anesthesia is still effective; one cannot feel hot drinks and one can burn easily. Same for eating things; when the anesthesia is still effective, the coordination of the tongue is impaired, it is easy to bite on tongue or cheek.*

9. *When the wound is bleeding persistently, a gauze can be applied to the wound and bite on it for 20-30 minutes. The bleeding will stop as a blood clot is formed. If bleeding continues, contact the surgeon*
10. *A fever can occur. Even up to 39º. If the fever persists more than one day, one should call the surgeon.*

MATERIALS

State trait anxiety inventory questionnaire

Prior to the surgical procedure a questionnaire regarding the state of a anxiety was filled in by the patients. In this study a Dutch version of the State Trait Anxiety Inventory (STAI DY-1) was used. Developed by Van der Ploeg, and Spielberger[33], it is the Dutch equivalent of the STAI developed by Defares and Spielberger. This scale contains 40 items on a self report questionnaire and includes a 4-point Likert response scale. The test contains two parts, the STAI version DY1 (first 20 items) and STAI version DY2 (last 20 items). These two parts differentiate between the present 'state anxiety' (DY1) and the general 'trait anxiety' (DY2). In this study the STAI-DY1, concerning state anxiety, was used. The rating scales and questions differ for each measure to ensure the reliability for both measures. The 4-point rating scale for state anxiety is as follows: 1.) not at all, 2.) somewhat, 3.) moderately so, 4.) very much so. The score ranging from 20-80, with a higher score correlating to greater anxiety. Low scores (20-39) indicate a low form of anxiety, median scores (40-59) imply a moderate form of anxiety and high scores (60-80) represent a severe form of anxiety. See appendix for the used version of the STAI- DY1.

Pain measurement

Evaluation of post operative pain was measured on a 100mm VAS, ranging from 0,0 (no pain) to 10,0 (worst pain imaginable). VAS is a widely used tool to record the pain experience in both clinical and research situations and has been previously shown to be effective to examine factors that affect the perception of acute pain in the dental situation.[33,34]

Pain- measurement rod (appendix A)

Participants were given a measurement rod for scoring the pain every day using the visual analogue score. The measuring rod is a ruler of ten centimeters, divided into one hundred millimeters on one side and a visual representation of a human face which expression varies from very happy (no pain, score 0,0) and screaming out and crying (worst pain imaginable, score 10,0). The rod is completed by a marking gauge. Participants would establish visually their state (comparing to the different faces on one side of the measuring rod), then use the marking gauge to slide up to the face which represent their state of pain at that moment and then turn over the measuring rod to establish to which extend they were in pain, expressed in a number.

Forms (appendix A-F)

For each participant five forms were used for different purposes:

1. **Informed consent form**. (appendix B)

2. **A form which contains the STAI-DY1 questionnaire and personal information.**

Age, gender, level of education and whether one smokes or not. distinction between the level of education was scored as 0 = primary school completed/ no education, 1 = secondary education completed, 2 = medium tertiary education, 3 = higher tertiary education, and 4 = academic level of education.

Furthermore the participants were able to fill in a question which they had in mind prior to and regarding the third molar removal and a question if they had obtained some information regarding the removal, for instance on the internet. This form was filled in entirely by the participants. (appendix C)

3. **Operation report.** (appendix D)
This form was used to describe the removal of the third molar. The following items were used, mainly to describe the course of the operation and filled in by the surgeon:
Were there symptoms prior to surgery?
Impaction of the third molar and nerve relation yes/no
Position of the third molar
The way of removal: elevator/forceps, alveotomy, alveotomy + splitting
Removal of the maxillary third molar
Extra local anesthesia
Special circumstances: none, tough, nerve in sight
Complications: massive hemorrhage, tough removal, collapse, left behind root remains, none
Operation time, start time, end time
Impression of the patient by the surgeon: calm, tensed, very anxious
Name of the surgeon

4. **Memorized information -score form** (appendix E)
This form was used to evaluate what the participants could reproduce of the instructions given. This form was filled in by the interviewer who, in all cases, was the principal investigator..

5. **VAS (Visual Analogue Score) -pain evaluation form** (appendix F)
This form was used by the participants to evaluate any pain experienced on a daily basis. Also on this form there is an opportunity to fill in any remarks on the course that day. With this form came a visual analogue score- measuring rod and an envelope which was franked and ready to be used to return the pain scores experienced.

Procedure
The participants were divided into three groups; a standard group who received their instructions in the operating room, prior to surgery. This group is called the standard group because it is how instructions are given up to date, and is group one. A pre-operative group who received their instructions face to face prior to surgery, group two. A post-operative group who received their instructions after the procedure was performed, group three.
The patients were assigned to one of three groups when they confirmed wanting to participate in this study, after they made an appointment for third molar removal. The subjects were appointed to one of the three groups in the following way: the first five patients were assigned to group one, the next five were assigned to group two and the next five were assigned to group three. Patients were assigned to a group this way until 35 patients per group were included. The patients were asked to come fifteen minutes prior to their appointment. Theoretically the patients were not at this time participants because no informed consent was obtained. This time was used to inform the patients about the study; what was expected of them and what they might expect from this study. This was done in a consulting-room. After a verbal explanation about the study, informed consent was obtained in all cases. Furthermore, the participants were explained how to use the VAS- measuring rod and how to fill in the VAS-pain evaluation form and to return it when no more pain is experienced. After obtaining informed consent the participants would fill in the STAI-DY1 form. When the STAI-DY1

form was filled in participants would go to the waiting room (depending whether they were in turn) or proceed the protocol:
Group 1, The Standard group: these participants continued to the operating room. In the operating room the participants would sit down in the operating chair and were given local anesthesia (Articaine 40 mg, adrenalin 1:100000). An operating assistant would create a sterile field to work on. This group received the instructions from the operating assistant, after the sterile field was created. The operating assistant read the instructions from a paper , in this way the instructions were the same for every patient.
Group 2, The Preoperative group: these participants were first given instructions by the principal investigator in the consulting room and after that continued to the operating room where local anesthesia was given followed by surgical procedure. The operating assistant nor the surgeon would give the patient information.
Group 3, The Postoperative group: these participants continued to the operating room where first the surgical procedure took place after giving local anesthesia. During surgery, no information was provided on the postoperative course by the operating assistant or surgeon. Immediately after surgery, the instructions to these participants were provided by the principal investigator in the consulting room.

All participants were told that after the surgical procedure they were expected in the consulting room again for some questions and to finish the contact properly. A time of twenty minutes was taken in account before the participants were asked what they remembered of the instructions given. For the first and second group the twenty minutes elapsed for the most during surgery. When less than twenty minutes elapsed, participants were asked to take place in the waiting room till the interview. For the third group the twenty minutes waiting time were used to get the prescription from the drugstore, also located in the hospital.
Back in the consulting room the participants were asked what they remembered from the instructions given. First there was an opportunity for the participants to tell what they remembered spontaneous. If the participants remembered spontaneous an instruction, this was scored as ten points. When participants could not remember more instructions, certain hints were given. A hint could be: 'there is a gauze in your mouth covering the wound; how long is it supposed to stay there?'. When a correct answer was provided a score of ten points were appointed. The instructions were scored as a spontaneous reproduction or as a reproduction with a hint. In either case a correct answer was scored. There was no difference in score if the participants remembered an instruction spontaneously or with a hint. After the interview was done, participants were remembered to return the VAS pain evaluation form when they experienced no more pain. Participants were asked if they could be phoned when no pain evaluation form was returned after three weeks to remember them. All participants received a prescription for pain medication (Brufen, 600 mg) and a brochure with information and instructions before they went home.

Statistical analysis
For the analysis both parametric as non-parametric tests were used. One way *ANOVA* was used when normal distribution could be achieved. Normal distribution was achieved for variables pain-day 3, pain mean, pain duration (time till pain-0) score. For the calculation of significance in the differences between the mean levels of pain perceived between the groups, first a *Kolmogorov-Smirnov (K-S)* test and a *Shapiro-Wilk (S-W)* test were used as a test for normality (as was for all further calculations in pain perception). A *log10 (lg10)* transformation and a *square root (sqroot)* transformation were performed in comparison to which achieved the most a normal distribution with the least *skewness.* Both showed a normal distribution in both the *K-S* and *S-W* test (P>0,05). *Figure* 1a and 1b show the Q-Q-plot of

each transformation in relation to the one and other and the original data. Obvious is the more linear pattern displayed by the Q-Q plot of the *sqroot* transformed data. For that reason a square root transformation was applied to the data. The data could then be analyzed using *ANOVA* test. This square root transformation was proven the best possible transformation applicable to every variable not having a normal distribution with the raw data. Therefore when transformation was needed for obtaining a normal distribution, a square root transformation was applied. Certain outcomes remained, even after various transformations, of non normal distribution. A non parametric test in the form of the *Kruskall-Wallis* test was used when data was violating assumptions for using an one way *ANOVA* test. Prior to each *Kruskal-Wallis test*, a *Levene's test* for equality of variances was performed to confirm homogeneity of variance between the groups for the different variables discussed. In this way no violations of assumptions were made, and therefore controlling for type I error. For the post hoc testing a *Mann Whitney U* test was used to detect significant differences between the groups individually. Before the test was performed a Bonferroni correction was applied, dividing the significance level by the number of tests performed.

Figure 1a: *log10 transformation*

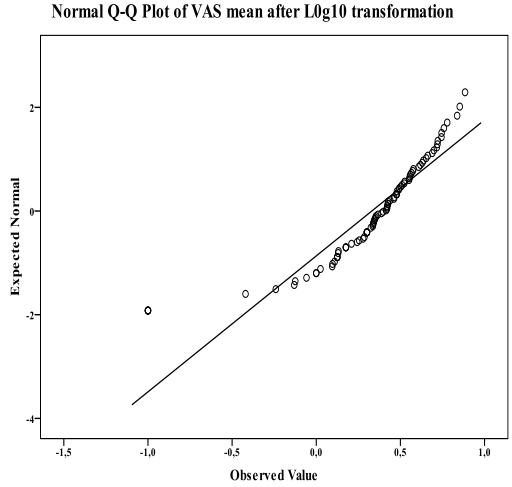


Figure 1b: *sauare root transformation*

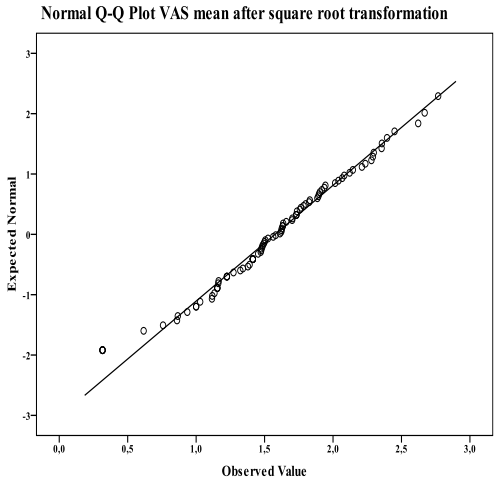


Figure 1a, 1b: The data for the VAS scores were not normal distributed. Therefore a transformation was applied if needed. This was done first for mean pain (VAS) score. After testing for normality data not showed a normality according to the k-s test. and/or s-w test. A Log10 transformation (figure 1a) and a square root (figure; 1b) were applied, with a normal distribution as a consequence, proven by both mentioned tests. Log10 transformation showed a skewness of -1.89 and square root transformation a skewness of -.23. For that reason a square root transformation was applied to the data. When looking at the Q-Q normality plot, it is obvious to the observer a more linear pattern occurs when a square root transformation is applied (figure 1b). This pattern and the difference in skewness was also observed in the other transformations regarding VAS sores day 3, and VAS duration, making square root transformation most suitable when compared to Log10 transformation.

RESULTS

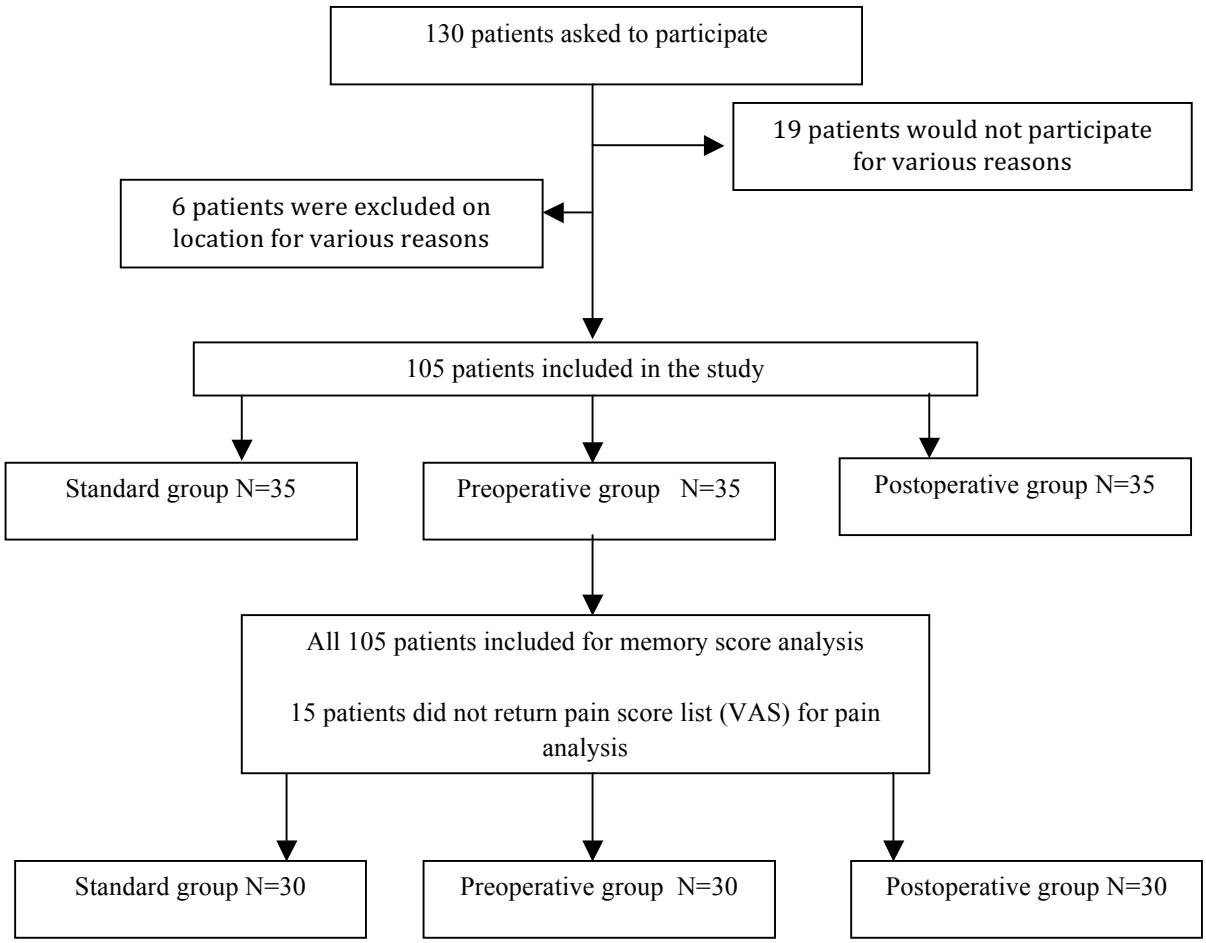
A total of 130 patients were asked to participate in the study. 19 patients would or could not participate for various reasons; Two patients made clear they had no time, three were not interested, one said he was too scared and it would be too stressful, two patients did not speak fluent Dutch, five patients had a surgical removal of a third molar less than a year prior to this appointment, and six people had their appointment either postponed or forwarded. On arrival

another six patients withdrew from the study; one participant was so scared she literally ran off after been giving local anesthesia, one participant declared he was not able to comply with the instructions concerning the pain-score list because of offshore work, one participant was mentally retarded so he was withdrawn from the study before informed consent was obtained, in two participants removal of the third molar was not necessary, and one participant was breastfeeding so no analgesics could not be taken.
A total of 105 patients gave informed consent and were included in study (50 men and 55 women). As not all patients complied with the instructions of returning the pain (VAS) score list, groups were set at 90 patients as soon as 30 patients in each group was had returned the pain. scoring list. A total of 43 men and 47 women were included.

The results will be presented in 3 sections:

1. *Demographical data, education, elapsed time from receiving instructions till reproduction of the instructions, and Anxiety (Table 1, figure 2, 3),*
2. *Memory scores (Figure 4 a,b,c)*
3. *Pain analysis (Table 2-5, figure 5)*

Figure 2: *Overview of inclusion of participants.*



For the memory analysis 105 patients were included and assigned to one of three groups. For the pain analysis 90 patients were included. The groups remained the same, except for those patients who did not comply with instructions on returning the pain score lists. Therefore, when 30 patients returned in each group returned the list, the group was complete. In that way the patients assigned to a group from beginning remained in that group. Pain was measured on a Visual Analogue Scale (VAS).

1. Demographical data, education, elapsed time from receiving instructions till reproduction of the instructions,

Table 1. shows an overview of the distribution of the participants in and between the various groups. Variables as age, level of education, the STAI-DY1 anxiety score and the mean elapsing time between receiving and reproducing the postoperative instructions are also displayed.

Table 1. Distribution of 105 participants in and between the groups.

Variables	Group 1	Group 2	Group 3	Total
Male	**15 (43%)**	**17 (49%)**	**18 (51%)**	**50 (52%)**
Female	**20 (57%)**	**18 (51%)**	**17 (49%)**	**55 (48%)**
Age	**26.5 ± 7.3**	**28.5 ± 11.5**	**28.5 ± 9.4**	**27.8 ± 9.5**
Education	**2.4 ± .73**	**2.3 ± .68**	**2.5 ± .85**	**2.4 ± .73**
STAI	**40.1 ± 10.9**	**43.3 ± 11.2**	**42.0 ± 9,0**	**41.8 ± 10.4**
MET (in minutes)	**21.0 ± 1.5**	**21.0 ± 1.8**	**21.0 ± 1.5**	**21.0 ± 1.5**

Table1: Age, level of education, the STAI-DY1 score and the mean elapsing time between receiving and reproducing the instructions are shown. MET = mean time elapsing. STAI = state trait anxiety inventory. The distinction between the level of education was scored as 0 = primary school completed/ no education, 1 = secondary education completed, 2 = medium tertiary education, 3 = higher tertiary education, and 4 = academic level of education.

<u>*Average age*</u>
The average age was 27,8 years (*SD*= 9,5 years). The median age was 25.0 years for all groups. A *Kruskall-Wallis* test showed no significant differences in the mean age between the groups $X^2(2, N=105) = .735$, $p=.69$

<u>*Education*</u>
The mean level of education was medium (2.4) for all groups. There were no significant differences amongst the groups $X^2 (2, N=105)= .612$, $p=.74$.

<u>*Elapsed time between obtaining instructions and reproduction of memorized instructions*</u>
The mean time elapsing between receiving instructions and reproducing these same instructions, was 21.0 min (*SD*=1.59). Median elapsed time was 20 minutes. There were no significant differences between the groups concerning the variable *elapsed time* $X^2(2, N=105) = .14$, $p=.49$. (*Kruskal-Wallis test*)

Anxiety

The mean level of anxiety (STAY-DY1-score) was 41.8 for all groups. A *Kruskall-Wallis* test proved no significant differences between the groups $X^2(2, N=105)= .13, p=.52$

Figure 3: *men, women, age in groups*

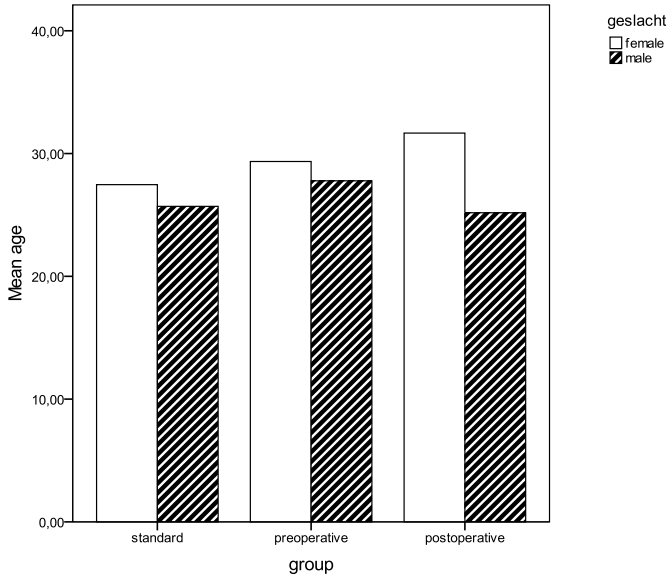


Figure 3: Distribution of men and women amongst the groups for memory analysis. On the x-axis the groups are displayed. On the Y-axis is the mean age displayed per group. The white bars represent the female participants, the colored bars represent the male participants. The groups turned out to be homogenous for these variables, as no significant differences were exposed.

2. Memory scores (Figure 3 a,b,c)

There was a significant difference between the groups for the memory score, with the lowest score in the standard group. For the analysis of the differences in the amount of information that was memorized (*memory scores*), the scores of all 105 participants were analyzed. *Figure 4a* shows the median score and standard deviation. For the groups in total the mean score was 81 points (*SD*=16), with the highest score in the postoperative group (*M*= 89, *SD*=11), the lowest score in the standard group (*M*= 72, *SD*=17) and in between those scores the preoperative group (*M*=83, *SD*=13). Because of the discrete character of the variable *score* an *ANOVA*-test could not be used for this analysis. *A Kruskal-Wallis* test was used instead. A *non-parametrical Levene's* test was used first and confirmed homogeneity of variance (p=<.05). The *Kruskal-Wallis* analysis revealed a significant difference between the groups, $X^2(2, N=105)= 20.2, p=.00$. Follow up tests were performed (*Mann-Whitney U*) to evaluate pair wise, the difference among the three groups. Controlling for Type 1 error across tests was done by using the bonferroni adjustment ($p=.05/3=.017$). The results of these tests indicate a significant difference between the standard group and the preoperative group, $z=-2.91$, $p=.004$, the standard group and the postoperative group, z=-4.3, p=.00, but not between the preoperative and postoperative group, z= -1.81, p=.07

Spontaneous memory versus memory with hint (Figure 3 b, c)

There was a significant difference in the spontaneous memory score versus the memory score with a hint. The mean for the *spontaneous memory* for all groups was 32 (*SD*=19). For the standard group the mean *spontaneous* memory score was 28 (*SD=17*), for the preoperative group 31 (*SD=19),* and 37 (*SD*= 22) for the postoperative group. For the *memory with hint* the mean score for all groups was 49 (*SD*=17), for the standard group 44 (*SD*=14), for the preoperative group 52 (*SD*=15), and 52 (*SD*=21) for the postoperative group. A *Kruskal-Wallis* test revealed no significant difference between the groups for spontaneous score $X^2(2, N=105)= 3.55, p=.17$, and a significant difference between the groups regarding score with

hint $X^2(2, N=105)= 6.21$, $p=.05$. After a *bonferroni adjustment* ($p=.05/3=.017$), a *Mann-whitney* test revealed a significant difference between the preoperative group (higher memory score) and the standard group (lower memory score) $z=-4.10$, $p=.016$, but not between the standard group and the postoperative group or the preoperative group and the postoperative group.

Score with hint and spontaneous score as percentages of the total scores in the groups

The score with hint as mean percentage of the total score was 62.0% ± 21.6 for the standard group, 64.0% ± 20.1 for the preoperative group and 58.7% ± 23.7 for the postoperative group. For the spontaneous score; 36.7% ± 21.2 for the standard group, 36.4% ± 20.4 for the preoperative group, and 41.0% ± 23.9 for the postoperative group. Because of the normal distribution of these variables an *ANOVA*- test was performed, which revealed no significant difference between the groups. $F(2, 103)= .57$, $p=.55$ for the score with hint and $F(2, 103)=.47$, $p=.63$ for the spontaneous score.

Figure 4 a: *median score*

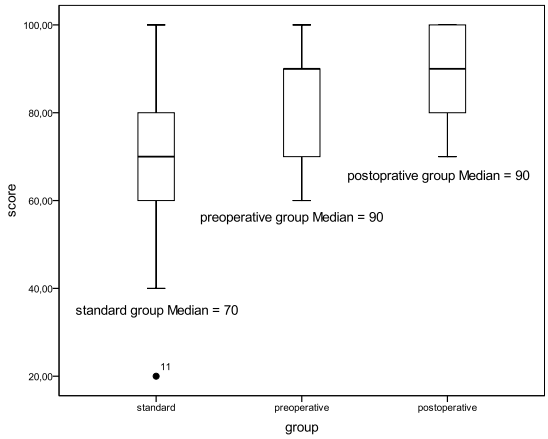


Figure 4 c: *median score with hint*

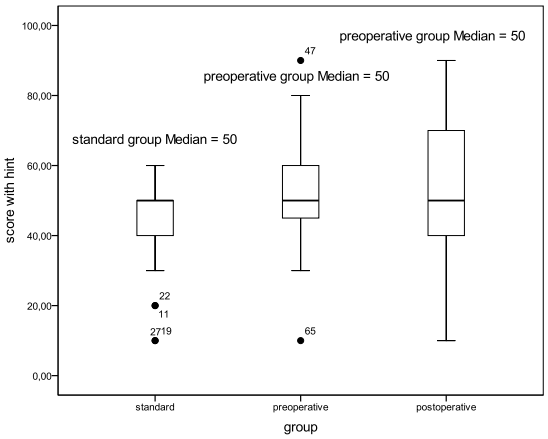


Figure 4 b: *median spontaneous score*

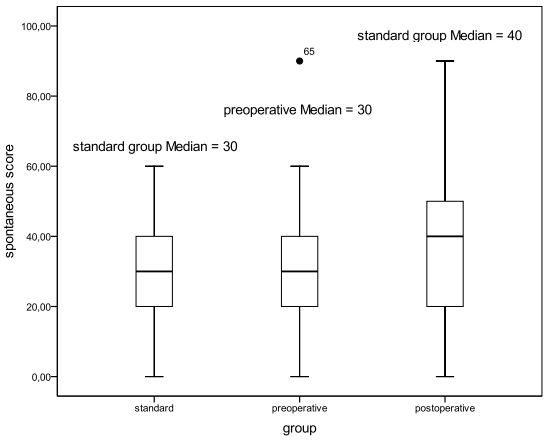


Figure 4a, b, c: Three boxplots giving an overview of the memory scores in the different groups. Upper left boxplot (a) gives an overview of the median scores in the different groups. The upper right (b) and the lower left boxplot (c) give an overview of the median score with hint and spontaneous score. Easy recognizable in boxplot (a) is the difference in median scores. The difference was significant for the preoperative group and the postoperative group when compared to the standard group. Patients in these groups reproduced significant more information than in the standard group.

Male versus female

A Mann-Whitney test revealed no significant difference between the scores of the male participants and the female participants $z=-1.95$, $p=.05$, with a higher mean score for female participants.

Education

Because education can have an influence on how much one can remember, the mean scores for the different levels of education were compared. A *kruskal-* test test showed a significant difference. A post hoc analysis in the form of a *Mann whitney U* test was used which, after bonferroni correction, failed to show any significant differences between the groups.

4.Pain analysis (Tables 2- 5, figure 5.)

A total sample of 90 patients were included for the pain analysis as not all patients complied with returning the pain score list. *Table 2* shows an overview of the distribution. There were no significant differences between the distribution amongst the groups regarding age, anxiety and level of education. Measured was the mean pain score, pain score on day 1, 3, 7, and pain duration.

Mean pain level

The mean level of pain is defined as the sum of all pain scores divided by the days patients report having pain. The mean observed in all groups was 2,8 (*SD*= 0,16), with a minimum of 0.1 and a maximum of 7.7. The mean level of pain experienced in the standard group was 2,4 (*SD*=1,2, range [0.74-5.6] In the preoperative group 3.0 (*SD*=2.1, range [.10-7.7]), and in the postoperative group 2,9 (*SD*=1.4, range [.10-7.7]) (Table 1.) Data was transformed through a *squareroot* (*sqroot) transformation* to obtain a normal distributed dataset. An *ANOVA* test suggests there is no significant difference in mean pain perception between the three groups, *F(2, 87)=.48, p=.63*

Pain duration

The results implicate a significant difference between the groups when it comes to the extent of duration of pain, measured in days, *F(2, 87)=4.2, p=.02* The mean number of days pain experienced (*time till VAS=0)* was 7,8 (*SD*=5,0). The mean for the standard group was 7,2 days (*SD*=5,0), for the preoperative group 6,4 days (*SD*=4,3), and 9.7 days (*SD*= 5.3) for the postoperative group. A *sqroot transformation* was applied to the data and an *ANOVA* test was used for analysis. A *bonferroni post-hoc* showed that the preoperative group (6.4 days) had a significant smaller pain duration than the postoperative group (9.7 days).

Pain at day one compared

Pain on day one was measured and is the first measurement following surgery. When the pain scores of day one were analyzed, no normal distribution of the data could be achieved through transformations formerly used. A *Kruskal-Wallis* test was therefore used for this analysis. Pain scores on day 1 did not differ significantly between the groups. $X^2(2, N=90)= 1.14$, $p=.57$.

Pain at day 3 compared

This day was also analyzed, because on the third day postoperative, swelling may be maximal which may increase the sensation of pain. For this data a *sqroot transformation* was used to achieve a normal distribution. An *ANOVA* test was used and a statistically difference was detected between the groups, $F(2, 74)=3.2$, $p=.05$. Standard group ($M=2.7$, $SD=1.9$), preoperative group($M= 4.2$, $SD= 2.5$), and the postoperative group ($M= 4.2$, $SD= 2.6$) A *bonferroni post-hoc analysis* could not reveal any significant differences between the groups. An independent sample t-test was therefore used to compare the groups. Which after *Bonferroni* correction also failed to reveal a significant difference.

Table2: Distribution of 90 participants in and between the groups for pain analysis

Variables	Group 1	Group 2	Group 3	Total
Male	**14 (47%)**	**15 (50%)**	**14 (47%)**	**43 (48%)**
Female	**16 (53%)**	**15 (50%)**	**16 (53%)**	**47 (52%)**
Age	**27.0 ± 7.6**	**29.6 ± 12.1**	**28.2 ± 9.8**	**28.3 ± 10.0**
Education	**2.3 ± .70**	**2.3 ± .71**	**2.5 ± .73**	**2.4 ± .71**
STAI	**39.0 ± 10.3**	**43.3 ± 11.1**	**42.0 ± 9,1**	**41.4 ± 10.2**

Table 2: Age, level of education, the STAI-DY1 score and the mean elapsing time between receiving and reproducing the instructions are shown. MET = mean time elapsing. STAI = state trait anxiety inventory. The distinction between the level of education was scored as 0 = primary school completed/ no education, 1 = secondary education completed, 2 = medium tertiary education, 3 = higher tertiary education, and 4 = academic level of education.

Table 3: Overview of the mean pain experienced, pain duration, pain on day 1, day 3 and 7

Group	Mean pain (VAS)	Pain duration (days)	Pain day 1 (mean ±SD)	Pain day 3 (mean ±SD)	Pain day 7 (mean ±SD)
Standard (n=30)	**2.4 ± 1.2**	**7.2 ± 5.0**	**3.5 ± 1.9**	**2.7 ± 1.9**	**2.8 ± 1.9**
Preoperative (n=30)	**3.0 ± 2.1**	**6.4* ± 4.3**	**3.7 ± 2.6**	**4.2 ± 2.5**	**3.8 ± 2.9**
Postoperative (n=30)	**2.9 ± 1.4**	**9.7* ± 5.3**	**4.1 ± 2.3**	**4.2 ± 2.6**	**3.1 ± 2.3**
All (n=90)	**2.9 ± 0.17**	**7.8 ± 5.0**	**3.8 ± 2.3**	**3.7 ± 2.6**	**3.2 ± 2.3**

Table 3: VAS= visual analogue score, pain duration = days till VAS = 0, * significant difference ($p<0.05$; ANOVA and Bonferroni post-hoc testing).

Pain at day seven compared

To compare the decline after seven days between the groups, the pain scores on day seven were also analyzed. The pain scores on day 7 did not show any significant differences. F(2, 46)=.44, p=.65.

Figure 5: *mean pain compared*

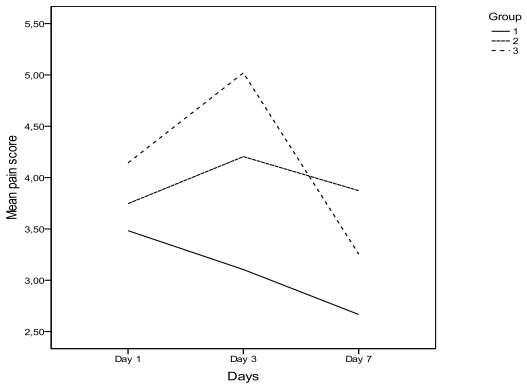


Figure 5: Lines represent the mean pain scores on day 1, 3 and 7. There is a peak at day three for the pre-and postoperative group. The peak in pain maybe a result of swelling that is most prominent at the third day postoperative and may therefore be responsible for the higher sensitivity of perception in pain. The standard group has a more linear decline. The pain scores in this group were significant lower in comparison with the other groups on day 3 ($p<.05$).

Postoperative complications

There were few complications. Out of 105 patients only 4 patients experienced complications as bleeding (1), delayed wound healing (2) and alveolitis (1). There were 13 patients who returned with complaints of pain all due to food impaction. The number of complications were too small for statistical analysis. Nevertheless, when patients that returned with pain complaints due to food impaction were grouped and compared to the all groups together regarding pain score day 1, mean pain score and duration of pain, a statistical difference was found. The data shows that food-impaction has an influence on postoperative pain. See *table 4*

Table 4: *differences in means on mean pain and pain duration with or without food impaction.*

	Mean pain	**Pain duration**
Total groups N=77	**2.5* ±1.3**	**6.8* ± 4.4**
food impaction group N=13	**4.6* ± 1.8**	**12.2* ± 5.6**

Table 4: Two groups compared; one group without the patients with food impaction and one group with patients that returned with pain complaints which were a result of food impaction. Food impaction was the main reason on which patients returned to the clinic. The patients that did have food impaction showed a significant higher mean pain experience and longer duration of pain, as the means of these variables are almost twice as high. * indicates significance at the 99% confidence level. (*Mann Whtiney U test*)

Because education, anxiety and age may influence memory function and scores, a correlation test *was performed.*

The correlations are rated as follows: If r = +.70 or higher is a very strong positive relationship, +.40 to +.69 is a strong positive relationship, +.30 to +.39 is moderate positive relationship, +.20 to +.29 is a weak positive relationship, and +.01 to +.19 is no or negligible

relationship. A Spearman correlation test was used to analyze if there was any correlation between memory scores and education, level of preoperative anxiety and age. This test indicates a weak positive correlation between the level of education and the memory score $r_s(88)=.30, p<.01$. However no strong correlations were found between level of pre-operative anxiety (*STAI-score*) $r_s(88)=.02, p>.01$.or age $r_s(88)=.02, p=.87$) on the memory score. See table 4 for an overview

Memory score

There was a positive correlation between the memory score and the pain score on day 1 and significantly predicted the pain score on day one and was for a significant proportion responsible for the variance amongst the groups. A *spearman* test was used to analyze the data and revealed a weak positive correlation between the memory scores and day 1 $r_s(88)= .23, p<.05$ and day 3 $r_s(75)=.19, p=.11)$, mean pain experienced $r_s(88)=.17, p=.10$ and the duration of pain $r_s(88)= .20, p=.06$. Despite of the positive correlations, only the correlation between the memory score and the pain score of day 1 was significant. A logistic regression was conducted to predict the pain score on day 1, using the memory score as predictor for a pain score higher than 3.6, which is the median pain score for all groups on day 1. A test of the full model against a constant only model was statistically significant, indicating that the predictor reliably distinguished between the memory score and the pain score on day 1. (*chi square=4.603, p*=.03 with *df*=1) Nagelkerke's R^2 of .07 indicated a relationship between prediction and grouping. The Wald criterion demonstrated that memory score made a significant contribution to prediction *p*= .04. EXP(B) value indicates that when the memory score is raised by one unit (10 points), the odds ratio is 1.03 times as large i.e. a higher memory score predicted significant a higher pain score on day one.

Duration of surgery

The mean time for duration of surgery was 7,6 minutes for all groups. A *Kruskal-Wallis* analysis showed no significant differences between the groups. To see if there was a correlation between the duration of surgery and the amount of pain experienced, a *spearman* test was used to analyze the data. No significant correlations were found between the duration of surgery and *VAS day 1* $r_s(88)= .18$, p=.89) and *VAS day 3* $r_s(75)=.16$, *p*=.17, *mean pain experienced* $r_s(88)= .19$, p=.07 and the *duration of pain* $r_s(88)= .12$ p=.24.

Anxiety

To see if there was a correlation between the anxiety score and the amount of pain experienced correlation tests were performed. Because of the non-normal distribution of the data *VAS day* 1, a *spearman* test was used to analyze the data. For the other variables a Pearson correlation could be used to analyze the *square rooted* data. The data showed no significant positive correlations between the anxiety and the mentioned variables. Pain score *day 1* $r_s(88)= .10$, p=.38, Pain score *day 3* $r_s(75)= .11$, *p*=.36), *mean* Pain score $r_s(88)= .16$, *p*=.13, and *time to VAS=0* $r_s(88)= .07$, *p*=.50.

Correlations VAS day 1, VAS day 3, time to VAS = 0, and VAS mean

As the data was analyzed, a strong positive correlation was found between pain day1 and the variable pain day 3 $r_s(75) = .53$, $p< .01$, a very strong positive relationship between pain day 1 and mean pain $r_s (88)= .77$, $p< .01$) and a strong positive relationship between pain day 1 and the duration of pain. $r_s(88) = .44$, $p< .01$. However, pain on day 1 was only moderate positive correlated to pain on day 7 $r_s (47)= .30$, $p< .05$ A Pearson's correlation test was performed and showed a very strong positive relationship between pain day 3 and pain mean $r(75) = .82$, $p<.01$, a strong positive correlation between pain day 3 and duration of pain $r(75) = .57$, $p<$

.01 and a strong relationship between pain on day 3 and pain on day seven $r(47) = .61$, $p < .01$ Pain on day 7 was very strong positive correlated to the mean pain $r_s\,(47) = .80$, $p < .01$) and strong positive correlated to the duration of pain $r_s\,(47) = .54$, $p < .01$ There was also a strong positive relationship between pain mean and duration of pain $r(88) = .56$, $p < .01$

Table 5: *predictors pain duration (time to VAS=0)*

Predictor	B	*β*	R^2	CI (.95) for B
VAS day 1	**.21 (.04)**	**.49****	**.28**	**.13 -.29**
VAS day 3	**.16 (.03)**	**.56****	**.31**	**.11- .22**
VAS day 7	**.11 (.03)**	**.46****	**.21**	**.05-.18**
VAS mean	**.35 (.06)**	**.57****	**.32**	**.24-.45**

Table 6: *predictors of mean pain score*

Predictor	B	*β*	R^2	CI (.95) for B
VAS day 1	**.18 (.02)**	**.77****	**.60**	**.14 -.21**
VAS day 3	**.15 (.01)**	**.80****	**.64**	**.12- .17**
VAS day 7	**.16 (.02)**	**.83****	**.68**	**.13-.19**
Duration	**.06 (.01)**	**.54****	**.30**	**.04-.08**

Table 5 and 6: Overview of the significant predictors of the duration of pain. The variables pain day 1, day 3, day 7 and mean pain score proved to be significant predictors of the duration of pain i.e. an increase in pain on one of the variables meant an increase in the duration of pain. Pain scores are measured on a Visual Analogue Scale (VAS). **indicates significance at the 99% level. Standard errors are reported in parentheses.

Method of surgery

Variables like the method of surgery can be of influence to which extend pain is experienced or how long pain is experienced. Method of removal could either be performed by *forceps*, *alveotomy* (drilling of the jaw bone), *alveotomy + splitting* (drilling of the jaw bone and splitting of the third molar), which all vary in degree of difficulty and extension of time with the first being less invasive than the latter. Therefore the surgery methods were examined to see if they are of any influence. A spearman correlation test showed no significant influence on the pain experienced on day 1, day 3, the duration of pain or the mean pain experienced.

Variables as predictors of VAS day 3, VAS mean, and VAS duration

Pain day 1 significantly predicted the pain score on day 3 β = .52, $t(75)=5.33$, $p<.001$, and also explained a significant proportion of the variance of the pain score on day 3 R^2 =.28, $F(1,75) = 28.41$, $p<.001$. Pain on day 1 also predicted significantly the pain score on day 7 β = .09, $t(47)=5.8$, $p<.05$, R^2 =.08, $F(1,47) = 4.2$, $p<.05$. Pain on day 3 significantly predicted pain on day 7 and was accountable for a great proportion of the variance on pain score day 7 β = .16, $t(47)=6.1$, $p<.001$, R^2 =..38, $F(1,47) = 28.4$, $p<.001$. *Table 5 and 6* give an overview of the predictability of variables proven to have a positive correlation.

DISCUSSION

In oral and maxillofacial surgery, third molar (wisdom tooth) removal is a very common procedure. It is a delicate procedure and is mostly performed under local anesthesia. Providing information and instructions about the expected postoperative course, is regarded to have a positive influence on postoperative outcomes. [2,3,5,6] It is a simple, non expensive way to contribute to adequate process of healing and contributes significantly to patients satisfactory with extension to benefits in healthcare in general and the economy. [15-17]

Many studies have investigated the influence of information[1-9], the way to provide information properly [30], and the influence of stress and anxiety on this information. [24-26] The best timing of giving verbal instructive information on postoperative course is subject for investigation.

In this study instructive information on postoperative course is provided, at three different moments and the amount of information remembered and the amount of pain is measured. In this way, we may detect any effect of information timing on memory and experience of pain.

Memory

In our study, significant differences were found between the amount of information remembered between the standard group and the preoperative group, the standard group and the postoperative group, but not between the preoperative and postoperative group. This is in accordance with our hypothesis, that the timing of providing information has an influence on the amount remembered.

Memory score and anxiety

The highest memory score was in the postoperative group i.e. receiving the information after the surgical removal of the wisdom tooth. The lowest memory score was in the 'standard' group, in which patients received the information in the operating room, immediately before surgery. An explanation for this may lie in the influence of fear. Several studies state that higher levels of anxiety are responsible for memory imprinting impairments leading to the

advice that information about the postoperative course or any information should not be provided just before surgery.[20-24, 26] Soh et al[21]who found that anxiety or dental fear rises gradually before surgery, reach a peak while receiving treatment, and undergoes a significant reduction after completion of the treatment. This may explain that the highest score was observed in the postoperative group which should be the group that has least anxiety. The standard group in our study scoring the lowest could therefore be explained by having a higher state of anxiety compared to the other groups and (more) impairment of memory imprint.

In our study no correlation was found between the anxiety and the memory scores. That may seem to contrast the statement of memory impairment due to anxiety being responsible for any difference. However, in this study anxiety was measured first and then the information was given. The anxiety was measured same for all patients in the 15 minute period where the patient filled in forms with personal data, and informed consent was obtained. The measurement has not taken into account for the possibility of a rise to a peak in anxiety just moments from surgery, which might negatively influence one's memory imprinting. No anxiety levels were repeated a second time, just before surgery or after surgery.

There was however data available that reflects the surgeons perspective on the state of anxiety of the patients, just before surgery. This interpretation of the patients anxiety by the surgeon was not always in accordance with the *STAI DY-1* (anxiety) score of the patients. No pattern was noticeable; patients sometimes appeared less anxious, sometimes more anxious and sometimes equally anxious in random order when compared to the interpretation of the *anxiety* score.

Memory score with/without hint

In our measurements, we decided to score the items remembered spontaneously, and remembered with a hint. The reason to do this is the thought that a patient who remember spontaneously is not only capable of undertaking action as an event occurs, but maybe even more capable of preventing that event. Therefore it seems of importance to investigate if there is any difference in the spontaneous memory versus the memory with hint. For example: one instruction was how to deal with a postoperative bleeding. If not spontaneously remembered, a patient may remember the instruction when the bleeding occurs; the occurrence of the bleeding can therefore be viewed as a 'hint'. For the spontaneous score versus the score with a hint, there was no difference between the groups. The scores as percentages of the total score in the groups, also did not differ.

Memory score and level of education

Because the level of education might have an influence on the ability to remember, a higher education may lead to a higher score on the memory test.[36] However, studies regarding preoperative information on postoperative outcomes did not find differences in the quantity of information patients with different levels of education can understand.[29,30]

In our study, a comparison between the groups showed a significance difference and a positive correlation between the level of education and the memory score. However, after an *ANOVA test*, a post hoc test failed to report a significant difference between the groups. Explanation might be the low number of people distributed within the different education levels (*level* 0 *n*=1, *level* 4 *n*= 6). Therefore no significant difference could probably be

revealed or denied with enough power. However, when means are compared for the individual group, a trend is seen. With a mean memory score of 75 for education level 0, 70 for level 1, and a score of 86 and 91 for education level 3 and 4, one might assume there is some influence of education in memory.

The *interview* regarding the memory was done verbally in this study. Study suggest that information can best be given verbally and written.[32] Verbally provided information is easily forgotten and differ significantly in terms of what a patient remembered of the instructions when compared to other forms or combination of forms to provide information. Because level of education seems to of an influence when it comes to verbally provided information, the mean level of education in the population is a parameter which has to be considered in developing the information about the postoperative course to an optimum at which there is the best understanding for any who receives these, regardless their level of education and therefore benefits of positive postoperative outcomes are exploited at full potential.

Pain

A significant difference was found between the standard group and the preoperative group, and the standard group and the postoperative group for the pain score on day 3. However a post hoc analysis did not reveal any significant differences between the groups. Thus, there might be a borderline significance or at least a trend. The *lowest* pain scores were found in the standard group. This opposes what might be expected from results shown by other studies [2,3,5,6,24,25], stating that information influences the pain perception to lesser extent.

An explanation may be differences in the content of the information presented to the patient. Studies that did find reduction in postoperative pain after providing information, often target their information directly at the anxiety of the patient or provide information about postoperative pain and what to expect. [2,3,5,6] In this way providing certain coping strategies and prepare the patient in a psychological way, oppose to the information provided in this study which prepares the patient in a more practical way. Vallerands'[28]study seems to underline this, when their study showed that patients who got specific information on pain and pain relieving measures, showed significant lower pain scores without increase in analgesic consumption in comparison with the control group who received open ended basic postoperative wound care instructions.

Another explanation could be that there are suggestions preparatory information can sensitize a patient to experience more pain. Various studies have concluded this[8,9]This might be the case in this study, although no real information was provided that was considered to raise any expectations towards pain experience.

Similar to that, there was a significant positive correlation between pain score on day one and memory score. In contrast to what might be expected it was a positive correlation i.e. the better the score, the higher the pain score on day 1. First explanation for that finding could be that the information provided was not for lowering anxiety, or expectations on pain and how to cope with that. Provided was information about the postoperative course regarding wound care, what to do and not to, and what to expect regarding swelling, bleeding and fever. Thus, with an emphasis on what the patient remembers, with emphasis on the more negative sequelae, and not on the altering of state of anxiety.

Gender and pain

The pain experienced as measured in our study was the same for men and women. None of the measurements different significant. Studies have suggest that there might be a difference when it comes to pain perception and differences between gender.[32, 36, 38] Women seem to have a lower anticipation towards pain than men, but have higher pain experience than men. Woman score higher in both the experience of pain as for the postoperative recollection of that pain to a various extend of time.

Pain day 1 as predictor of pain

The pain score of day one proved to be a significant predictor of the pain score day 3, pain mean, and duration of pain. The higher the score on pain day one, the higher the score on these other variables. Also the pain score of day three was strong correlated to the duration of pain.

There are several studies that have discovered possible predictors of postoperative pain on the first day postoperative. One of these predictors are the preparatory instructions that were found of significant influence on the pain outcomes 12-24 hours postoperative. [28, 38]

This is in accordance with this study, because this study showed a significant correlation between the memorized information and pain on the first day. However, since this study found a correlation that more memory is correlated to more pain, the true value of instructive information on postoperative pain has to be established through further research.

Another predictor that has been investigated is the operation time (duration of surgery) and whether the tooth was sectioned or not. Both were of influence of the experienced pain on the operation day and slightly of influence the first 48 hours postoperative in another study performed.[38] No relationship between duration of surgery or tooth sectioning and postoperative pain were observed in our study. Must be mentioned that in the mentioned study the duration was of significant influence only when exceeded 31 minutes, a time which is very extensive for a third molar removal**.** In that terms operation time is a weak predictor for pain experienced shortly after surgery as duration of surgery to this extend will not often be required. Also questionable is the power which that predictive influence was measured in by the authors of the study, as not many patients would be available for any significant correlation to be measured with enough power. For instance, the mean time for all groups for surgical mandibular third molar removal in this study was 7.6 minutes with a maximum of 26.0 minutes, only occurring once in 90 patients.

Food impaction

Not many patients returned with complications. Out of seventeen patients that returned, thirteen (76%) returned with pain complaints due to food impaction. Patients that returned with complaints of food impaction, had a higher mean pain, and a longer pain duration. Food impaction is easy to avoid by flushing the wound with a rinse, after being properly instructed on use of the rinse. Further study on the impact of food impaction on postoperative pain sensation, duration and overall patient satisfactory should be executed. More patients should be included to see the predictive value of food impaction. Although patients with food impaction experienced more and longer pain, they were not excluded from this study. The patients with food impaction were few and equally distributed over the groups to be of any significant influence within the groups compared to the other groups.

Strength and weakness of the study

Homogeneity

The different groups turned out to be homogenous with no significant differences in the variables age, gender, level of education and anxiety level. No bias favoring one of the groups over the other if any of these variables correlates, as independent variables, to a measurement outcome. This makes it a powerful study in terms of homogeneity between the groups. This is the same for the groups in both memory analysis (*n*=105), and for the pain analysis (*n*=90)

Distribution of the participants

The distribution of the patients over the groups was not executed by randomization using a computer. Instead, every five patients were appointed to a group when declared to participate in the study. For further investigation this way of randomization is susceptible for improvement.

Power of the study

Although the studies' main focus was the influence of timing of giving instructions on memory imprinting, the standard deviation necessary to obtain a accurate sample size trough power calculation was derived from studies that involve pain scores. The reason for this is the few studies regarding timing of giving information, could not sufficient provide a reliable estimation of the standard deviation needed to calculate the sample size. From an early calculation the intended sample size was 20 per group. Power was calculated as follows; a clinical relevant difference was set to be 1-1,5 points on the 100mm pain scale between the groups. When pain data from other studies is analyzed a standard deviatation of 1,4 is derived. A difference of 1,3 between the means was found. Using this information for the power calculation using the online G power 3.1.6 calculator for *ANOVA* sample size, than the following sample size is derived; with an effect size (F)=0,4714, a total sample size of 48 persons emerges. To have a backup for any exclusions the total sample size was set to 60, which is 20 subjects appointed to each group. This sample size is corrected up to 30 patients in each group, because of anticipation that a normal distribution of the pain-scores, could not be achieved. An *ANOVA test* would not be useful in comparing means and a *Kruskal-Wallis* test had to be used instead. Because the sample size would not be sufficient for a *kruskal-wallis* test, which proves significant differences with less power, the groups were enlarged. No power calculation was done before the enlargement of the groups. There will be no post hoc analysis as it is only of use when sample sizes are calculated before proceeding to the actual execution of the study.[39]

Education

When the influence of education was analyzed, there was a significant positive influence observed when linear regression was performed on this data. A significant difference was detected in memory score when compared to differences in level of education. However, no significant difference emerged after post hoc testing. This can be explained by the fact that too few participants were assigned to the levels of education that differ most in means level 0 (*n*=1), level 1 (*n*=3) and level 4 (*n*=6). Therefore any significant difference is probably not determined with enough power.

Memory testing

The way memory was tested is open for discussion. It has been proven that verbal information, or even receiving verbally information is easily forgotten.[33] In clinical practice it would be better to have also written instruction in addition to the verbal information.

However, it was deliberately chosen to provide information in one way, so that only the effect of verbal information could clearly be assessed.

Another remark concerning the methodology of the study is that the verbal information in the standard group was provided by the operating assistant. They provided information by summing up the ten information about the postoperative course stepwise from forms. The preoperative group and postoperative group were instructed face to face by the principal investigator in a separate consulting room, which has a more relaxing environment when compared to the operating room. The *setting* may be responsible for the differences in memory imprinting. In the operating room, the patient is set on the operating table, is draped with operating sheets to create a sterile field; all factors that maybe contribute to an extra rise in anxiety and therefore impairing memory. But setting and timing are bound together in this case. The way the instructions are given up to this day, is as in the standard group. Therefore it is called the *standard* group. So if one wants to investigate if timing has an influence, it is inescapable that the setting has to be changed also. Which also confirms the hypothesis that the timing of giving information about the postoperative course is of importance when it comes to memorizing and reproducing these instructions, as the timing defines the setting for the standard group.

Interview by the principal investigator to obtain remembered information from the patient
The interviewing of the patients regarding what they memorized, was done by the principal investigator. This interview on what a patient remembered also was performed in a verbal way. Though all participants were questioned by the main author, no real protocol was established to determine *how* to ask the questions. The spontaneous memory was examined first. The patient would be given the opportunity to tell what was remembered from the instructions, without intervention. When patients could not produce any more answers, the main author would provide hints. This was done from a form which contained the 10 instructions and what answer was required when to score what was memorized. The way hints were provided was slightly different every time, as the *interview* was open to variations in approach and order, for a great amount depending on what the patient told spontaneously. To the opinion of the authors it had no influence on the actual data outcome because specific care was taken to provide the hints in the same way every time. The verbal approach is also in favor of this study. Because of the verbal explanation and questioning, no multiple choice questions were available for patients to fill in memorized information. Therefore the answers provided by the participants were memorized and not recognized as could be the case as multiple choice questions contain wrong answers from which one can deduct the right answer. There is also the fact that patients in the postoperative group did not had surgery in between receiving and reproducing instructions. Instead they completed the time in between to get analgesics from the drugstore in the hospital.

Pain analysis
The patients all received a brochure which contained the verbal instructions provided. A justified remark would be that no difference in pain was measured because all patients were able to read the instructions at home and thereby leveling all differences in information memory and its effect on postoperative pain. The opinion of the authors it was not ethical to provide no brochure, as it is a standard procedure. The influence of this brochure to the outcome in pain analysis is disputable, as it is the experience of the surgeon that the brochure is not often read, a statement which is in accordance with the study of Blinder.[32]

Future perspectives

Combining the literature with results of this study it seems important to lower the pain on the first day because of possible further positive influence on pain perception postoperative. It seems obvious further investigation should be performed regarding the relation between the pain score shortly postoperative and the further progression of pain. The pain is likely to be related to preoperative anxiety, pain expectation and surgical methods. Further investigation in those areas would be justified, although further investigation into the influence of information about the postoperative course on postoperative pain is also relevant according to results provided by this study.

Because the information was given verbally, it is of importance that the information is provided in such way that it is best received and remembered by the patients. Therefore it is of importance to investigate what the influence of the setting is as the information was given face to face whilst sitting in a consulting room. Because there is not always enough time and no consulting room available to sit down and provide this information, it may be that when the verbal information is given face to face in the operating room after surgery it is equally efficient. This is of importance because it saves time and room which translates in a more efficient way of providing care to all patients and raises the capacity of the clinic. This way creating a more cost effective production and less pressure on healthcare costs in general.

When information is intended to reduce pain, then it is of importance to provide other information than instructions regarding postoperative wound care and how to avoid complications, as provided in such way as in this study. Further investigation is needed to investigate which kind of information is applicable for obtaining a desired influence on postoperative outcomes. From studies performed up to date, it seems obvious that coping strategies and altering one's expectations regarding pain by preoperative teaching and information seems necessary in reducing postoperative pain.

From the literature in general it seems that information has an influence on postoperative outcomes when taken into account the intended postoperative outcomes and patients' wishes and level of understanding. Best would be a combination of verbal and written information, understandable to any patient concerning. Further investigation into the use of multimedia seems logical as it is more a part of everyday life in human society. The findings in other studies and this study justify further research in the area of providing information on postoperative outcomes to patients, especially when regarding the timing of providing verbal instructive information about the postoperative course.

CONCLUSIONS

Memory

Instructive information on the postoperative course of third molar removal seems to be best remembered when given after the surgical event.

Pain

The timing of this information does not seem to have an effect on postoperative pain perception. This may be related to the content of the instructions, that were not targeted at pain perception.

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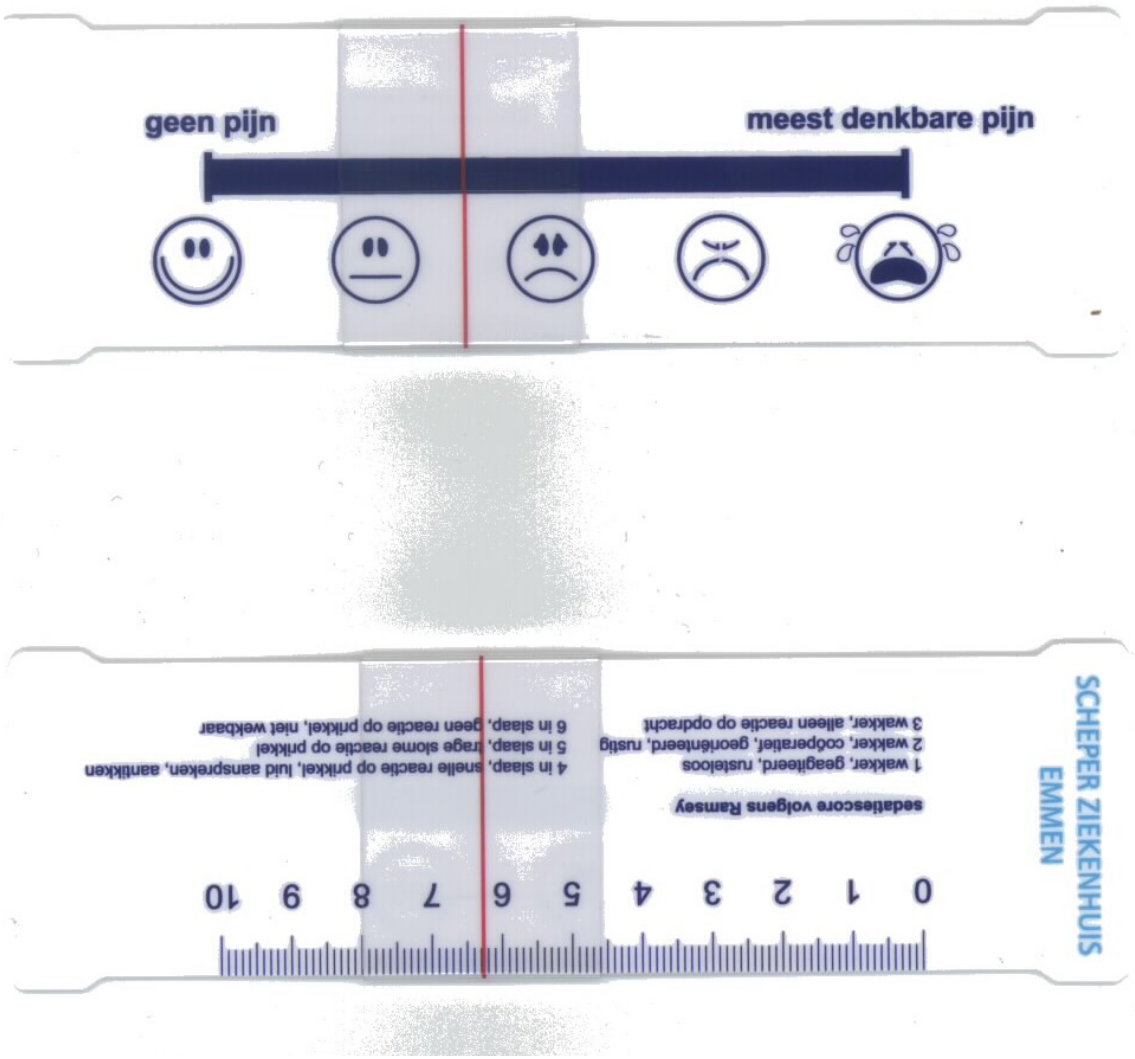
Appendix A: Visual Analogue Scale- measurement rod



Appendix B: inform consent form

Informed Consent

Onderzoek naar pijn na verstandskiesverwijdering en informatievoorziening.

Ik ben voldoende ingelicht over het onderzoek.

Hierbij verklaar ik dat ik mee zal werken aan het onderzoek naar het effect van informatievoorziening op pijn na het verwijderen van een verstandskies.

Dit houdt in dat ik dagelijks de pijnscores op de lijst invul. Nadat er geen pijn meer aanwezig is, zal ik de scorelijst retourneren.

Ik begrijp dat het meedoen aan dit onderzoek op geheel vrijwillige basis geschiedt. Ik behoud mij het recht om mij op elk moment uit de studie terug te trekken, zonder opgaaf van reden. Dit zal geen effect hebben op de reguliere zorg. (behandeling of komende behandelingen)

Datum:

Plaats: Emmen

Naam:

Handtekening:

Appendix C: Form which contains the STAI-DY1 questionnaire and personal information.

ZELF-BEOORDELINGS VRAGENLIJST
Ontwikkeld door H.M. van der Ploeg, P.B. Defares en C.D. Spielberger.
STAI · versie DY·1

Naam: ..... Sekse: ..... Datum: .....
Opleiding: (omcirkelen wat van toepassing)

GEEN

VMBO/MBO

HAVO/HBO

VWO/WO

Roken: Ja/nee (doorhalen wat niet van toepassing)

Toelichting: Hieronder vindt U een aantal uitspraken, die mensen hebben gebruikt om zichzelf te beschrijven. Lees iedere uitspraak door en zet dan een kringetje om het cijfer rechts van die uitspraak om daarmee aan te geven hoe U zich *nu voelt*, dus *nu op dit moment*. Er zijn geen goede of slechte antwoorden. Denk niet te lang na en geef Uw eerste indruk, die is meestal de beste. Het gaat er dus om dat U weergeeft wat U *op dit moment* voelt.

	geheel niet	een beetje	tamelijk veel	zeer veel
1. Ik voel me kalm	1	2	3	4
2. Ik voel me veilig	1	2	3	4
3. Ik ben gespannen	1	2	3	4
4. Ik voel me onrustig	1	2	3	4
5. Ik voel me op mijn gemak	1	2	3	4
6. Ik ben ik de war	1	2	3	4
7. Ik pieker over nare dingen die kunnen gebeuren	1	2	3	4
8. Ik voel me voldaan	1	2	3	4
9. Ik ben bang	1	2	3	4
10. Ik voel me aangenaam	1	2	3	4
11. Ik voel me zeker	1	2	3	4
12. Ik voel me nerveus	1	2	3	4
13. Ik ben zenuwachtig	1	2	3	4
14. Ik ben besluiteloos	1	2	3	4
15. Ik ben ontspannen	1	2	3	4
16. Ik voel me tevreden	1	2	3	4
17. Ik maak me zorgen	1	2	3	4
18. Ik voel me gejaagd	1	2	3	4
19. Ik voel me evenwichtig	1	2	3	4
20. Ik voel me prettig	1	2	3	4
	geheel niet	een beetje	tamelijk veel	zeer veel

Vraag:
Wat vindt u belangrijk om te weten na de ingreep?
Antwoord:

Heeft U naar informatie gezocht met betrekking tot de ingreep, bijvoorbeeld op het internet? Ja/Nee (doorhalen wat niet van toepassing is)

Appendix D: Operation report

Scorelijst M3 – informatie/ VAS
Naam:

Ponsplaatje:

Datum:

Symptomatisch Ja/Nee

Stand:

38: impactie: naar distaal, vertikaal, naar mesiaal, horizontaal: nervusrelatie ja/nee

48: impactie: naar distaal, vertikaal, naar mesiaal, horizontaal: nervusrelatie ja/nee

Verwijdering van 38 / 48:

38:	per elevatorum/forceps	Alv tomie	Alv tomie + splitsen
48:	per elevatorum/forceps	Alv tomie	Alv tomie + splitsen

Verwijdering 18 / 28

Bijverdoofd: Ja / Nee

Bijzonderheden: geen / lastig / nervus a vu: ja / nee

Complicaties: (erge)bloeding/ collaps/ achterblijven wortelrest/ zeer moeizame verwijdering

Duur ingreep: start tijd……eindtijd…….Duur:…….minuten

Patient was: rustig/ gespannen/ erg nerveus

POSTOPERATIEF:

- Nabloeding:	JA/NEE	Datum..
- Eerder retour nabezwaren:	JA/NEE	Datum ..
- Alveolitis:	JA/NEE	Datum..
- Abcedering/infiltraat	JA/NEE	Datum
- Hematoom	JA/NEE	Datum
- Voedselimpactie	JA/NEE	Datum

Naam operateur:

Appendix E: Memorized score –form

Scorelijst patienten

Naam: Leeftijd:

Datum: Tijd:

Ponsplaatje

Groepen:	Groep: 1	Groep: 2	Groep: 3
	STANDAARD	PRE-OK	POST-OK

Instructie	Medegedeeld ja/nee	Onthouden spontaan	Onthouden met hint	Score
1 Gaasje eruit				
2 Verdoving uitgewerkt, pijstilling nemen				
3 Spoelen				
4 Hechting lost op				
5 Beloop: Zwelling+ pijn				
6 poetsen				
7 Koelen				
8 Eten/drinken				
9 Nabloeding				
10 Koorts				

Appendix F: VAS (Visual Analogue Score) -pain evaluation form

VAS Scorelijst M3 – informatie

Naam:

Ponsplaatje:

Datum:

VAS = 0 (geen pijn), VAS = 10 (ergste pijn)

Elke dag op zelfde moment scoren, om 12:00 uur. Wanneer VAS = 0, dan graag retourneren aan polikliniek kaakchirurgie, Emmen. (enveloppe is bijgevoegd, frankeren is niet nodig)

DAG	VAS	Opmerking:
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		