ORIGINAL RESEARCH

A Retrospective Analysis of Postoperative Abscess Formation Following Wisdom Tooth Removal and Their Clinical Condition and Localization

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Abstract

Aim: As a common procedure in oral surgery, the removal of wisdom teeth (3M) is associated with a variety of postoperative complications. This study reports of deep tissue abscesses after the removal of 3M in correlation to several factors.

Materials and methods: Patients between 2012 and 2017 with removed 3M were retrospectively evaluated in terms of clinical condition and localization and thus assigned tog A (removal of asymptomatic 3M) or group B (removal of symptomatic 3M). Moreover, they were analyzed in terms of abscesses after the removal and correlation with various parameters: localization of the abscess, general diseases, perioperative antibiotic treatment, number of days from removal of the tooth to abscess formation, and postoperative complications after primary abscess incision.

Results: About 82 patients (male $n = 44$, female $n = 38$) were included, with 88 wisdom teeth removed and postoperative abscesses. Postoperative abscesses occurred more frequently in group B ($n = 53$) with $n = 29$ in IIB localization, without a significant correlation. Patients in this group were older, and there were more surgical abscess incisions needed, despite a longer treatment with oral and intravenous antibiosis that correlated with neurologic diseases and age. Younger patients reported significantly more pain.

Conclusions: Detection of potential 3M pathologies at an early and asymptomatic stage is essential to avoid postoperative complications following 3M removal. Additional prospective studies are necessary to develop corresponding guidelines.

Clinical significance: Wisdom tooth extraction is the most common operation in oral surgery, and therefore, adequate risk evaluation is still required.

Keywords: Abscess, Complications, Oral surgery, Wisdom tooth.

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Introduction

The removal of wisdom tooth remains one of the most common procedures for oral surgeons.[1] The regular eruption of wisdom teeth occurs between the ages of 15.6 and 23.4 years in girls and 18.2 and 23.4 years in boys.[2] In 14% of cases in girls, at least one wisdom tooth is completely missing, occurring more frequently in the maxilla than in the mandible.[3,4] In addition, approximately 84% of mandibular third molars (3M) are fully or partially unerupted at age 20. About 91% of those fully impacted at age 20 remain so throughout life.[5]

In current literature, removal of 3M is associated with a variety of postoperative complications, whereby the prevalence of complications differs widely (4.6–30.9%) in studies.[6–9] Postoperative swelling or pain, trismus, sensation disorders of the lingual or inferior alveolar nerve (IAN), a dry socket, osteitis or abscesses are the commonly found complications.[10,11] One study examined 463 patients with 665 wisdom teeth removed over 10 years. With an incidence of 11.6%, the most common complication was alveolitis sicca, associated with partially retained teeth in 67.3%. In addition, the authors found that patients older than 36 years had a fourfold increased risk of developing postoperative complications, and nicotine abuse increased their risk of complications.[12] In another study, the authors surveyed 55 patients after upper wisdom teeth removal. Of the teeth removed (40% partially retained and 51% fully erupted), 50% were asymptomatic, and 50% were classified as symptomatic due to pericoronitis. The patients with fully retained teeth (9%) reported greater postoperative pain than the others. The complications reported were soft-tissue injury in only 21% of cases and fracture of the tuber maxillae in 13%.[13] Another study, observing postoperative complications following mandibular wisdom teeth extractions ($n = 330$) in 250 patients, found wound-healing disorders to be the most frequent complication (5.8%), followed by alveolitis sicca (2.7%) and damage to the IAN (0.6%).[14]

There is still controversy among clinicians regarding the indication and perfect point in time for 3M removal. Results from a recent prospective multicenter study with 1.826 removed lower 3M show that age (cutoff 35 years) and the location of the 3M (deeply impacted) are independent risk factors for the development of postoperative complications.[1] However, in this study, as with

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most other immediate postoperative complications, they were self-limiting at 6 months. Thus, it can be hypothesized that no further hospitalization and a shift in the cost–benefit ratio can actually be expected from these consequences. This means that such complications do not imply further surgical interventions or burdens on the healthcare system, although these remain crucial for the patient.

Similarly, prophylactic vs. therapeutic 3M removal is always a focus of debate. Prophylactic removal is usually associated with asymptomatic teeth, and therapeutic removal is associated with symptomatic teeth.[15] However, it is also stated that clinically symptom-free does not necessarily mean without pathologies.[16] Some studies and case reports indicate that an increased hospitalization rate can be expected in case of symptomatic 3M removal due to the occurrence of more extensive complications, such as deep tissue abscesses, in comparison with prophylaxis-induced morbidity.[17,18] On the contrary, other studies stated that the occurrence of such complications has a higher association with prophylactical 3M removal.[19–21]

To further clarify these issues, this retrospective analysis investigated on abscess formation after the removal of wisdom teeth.

Materials and Methods

Study Design and Setup

This retrospective study was conducted in the Department of Oral and Maxillofacial Surgery at the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU). It was approved by the Ethics Committee of the FAU (177_19Bc).

Data of all the patients in the Department of Oral and Maxillofacial Surgery at the FAU in Germany from October 2012 to February 2017 were screened for a deep tissue abscess following wisdom tooth removal. Inclusion criteria were the relation of the abscess to the location of the 3M. In addition, patients who underwent removal within this department or also others were included. The screening process for the patients was performed with patient charts. Therefore, consistent information on duration of surgery, experience of the surgeon, or extent of surgical intervention could not be obtained in all cases and could be considered in the evaluation only to a limited extent.

The exclusion criteria were missing patient data (especially documented clinical signs of inflammation) or radiographs to determine whether the removed wisdom tooth was symptomatic or asymptomatic or its localization. Asymptomatic in this term was defined as free of clinical symptoms and radiological pathologies. Whereas symptomatic was in terms of present clinical symptoms (signs of inflammation, i.e., bleeding, swelling, and pus) or radiological pathologies (i.e., bone inflammation processes).

The included patients with abscesses were retrospectively assigned to group A (asymptomatic wisdom teeth) or group B (symptomatic wisdom teeth). The classification of the localization of 3M was correlated to the groups according to the Pell–Gregory classification.[22] The angulation was recorded according to the Winter classification.[23] This classification is widely used for predicting the difficulty of extraction and is based on its spatial relationship to the ascending ramus of the mandible and occlusal plane.

In all cases, the deep-tissue abscess was drained extra- or/and intraorally in local or general anesthesia according to its location and extension Moreover, adjunct antibiotic agents (i.e., amoxicillin 1000 mg or clindamycin 600 mg) were applied empirically orally or intravenously with an adapted dosage and with concomitant hospitalization.

Variables and Data Collection Methods

We analyzed the patient data according to the following parameters:
Localization of the abscess.
General diseases.
Perioperative antibiotic treatment.
Number of days from removal of teeth to abscess formation.
Postoperative complications after primary abscess incision.

Outcomes

The primary outcome was defined as the occurrence of postoperative abscess formation after the removal of wisdom teeth according to the preoperative asymptomatic or symptomatic state and its localization. The secondary outcome parameters were localization of the abscess, general diseases, perioperative antibiotic treatment, number of days from removal of teeth to abscess formation, and postoperative complications after primary abscess incision.

Data and Statistical Analysis

SPSS software, version 24 (IBM, Armonk, New York, USA), was used for statistical analysis. The association of each variable with abscess occurrence was analyzed with the nonparametric Mann–Whitney *U* test for ordinal variables and with Fisher's exact test or Chi-square tests for categorical variables.

The descriptive presentation of the correlations was performed by the correlation coefficient *p* (Spearman correlation) of the compared parameters. The significance level $p = 0.05$ was subjected to a Bonferroni correction for each parameter.

Results

Patient Cohort

In total, 88 wisdom teeth removed with postoperative abscess formation (patients $n = 82$; male $n = 44$, female $n = 38$) were included from 148 removed wisdom teeth in total. The overall average age was 33.24 ± 15.51 years; in group A, it was 26.54 ± 13.18 years; and in group B, it was 37.82 ± 15.4 years. Patients in group B were thus on average 11.37 years older, which was statistically significant (tested by Mann–Whitney U test with a *p*-value of <0.001). In total, there were 44 male and 38 female patients, which were split into group A, with 14 male and 19 female patients, and in group B, with 30 male and 19 female patients. There was no statistically significant difference between male and female patients (Fig. 1; Chi-square test, *p*-value 0.097).

Age in total correlated significantly with the number of surgical abscess procedures ($p = 0.037$). The higher the age, the more abscess treatment procedures were needed. There was no statistically significant correlation between the number of surgical abscess procedures and the single groups.

There was a statistically significant correlation between postoperative pain and the age of the patients. Younger patients had more postoperative pain (measured by the visual analog scale during the stay in hospital) than older patients (Spearman correlation: p (groups A + B) = −0.361, $p < 0.001$; p (group A) = −0.373, $p = 0.032$; and p (group B) = −0.288, $p = 0.044$).

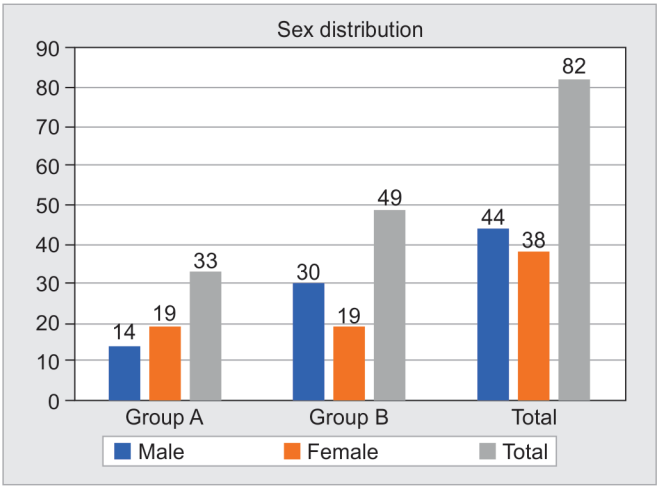

Fig. 1: Sex distribution according to the groups A and B within the patient cohort

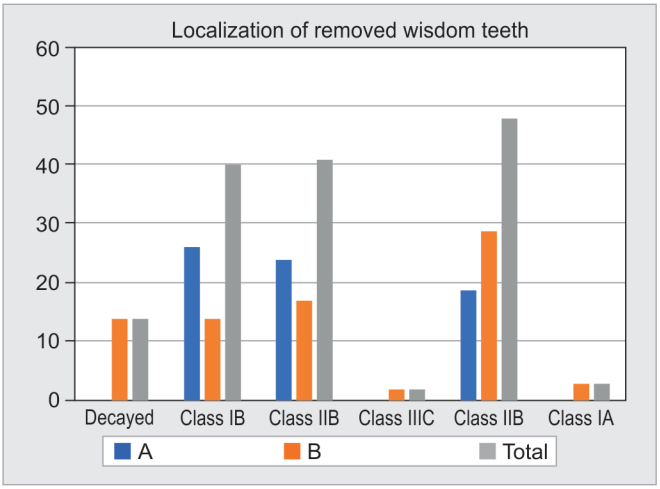

Fig. 2: Localization of the removed 3M with postoperative abscess according to the Pell–Gregory classification

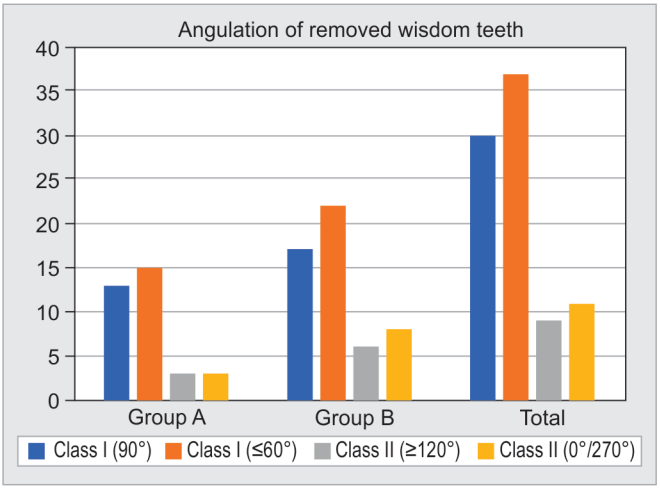

Fig. 3: Angulation of the removed 3M with postoperative abscess according to the Winter classification

Table 1: General diseases according to the groups A and B within the patient cohort

General diseases	*Total n = 82 (n = patient)*	*Group A (asymptomatic)*	*Group B (symptomatic)*
Cardiovascular diseases	7	0	7
Respiratory diseases	4	1	3
Bleeding disorders	3	2	1
Diseases of the digestive tract	7	4	3
Neurological diseases	8	3	5
Thyroid disease	4	2	2
Metabolic diseases	12	3	9
Alcohol-/Nicotin-/ Drug-abuse	6	2	4

Primary Outcome

The formation of a postoperative abscess occurred in 35 wisdom teeth removed in group A and in 53 in group B. Thus, the occurrence of postoperative abscess formation was higher after the removal of symptomatic teeth, but the difference was not statistically significant. The localization of all 3M is shown according to the Pell–Gregory classification (Fig. 2).[22] The angulation of the 3M according to the Winter classification is shown in Figure 3.[23] There was no significant correlation between the groups A and B and their localization, whereas $n = 29$ was assigned to class IIB in group B.

Secondary Outcomes

Localization of the Abscess

The overall localization for deep-tissue abscesses was in the submandibular ($n = 26$), paramandibular ($n = 16$), buccal region ($n = 14$), and perimandibular region ($n = 13$). The other regions where the abscesses were located were temporal region, M.masseter, masticator region, parapharyngeal region, or retromandibular region.

General Diseases

The general diseases of the patients are shown in Table 1. Statistically significant differences between the groups were found only for cardiovascular diseases (Fisher's exact test, $p = 0.038$). Moreover, a significant correlation could be seen with the number of necessary postoperative abscess incisions and neurologic diseases (schizophrenia, depression, Parkinson's disease, and epilepsy) in group A (Spearman correlation: p (A + B) = 0.462, $p = 0.001$; p (A) = 0.697, $p = 0.001$; and p (B) = 0.301, $p = 0.035$). The included patients had no otherwise-described medical conditions (such as diabetes), nor any history of described habit.

Perioperative Antibiotic Treatment

For both intravenous and oral application, the median in group B (oral 7 days, intravenous 6 days) was higher than the median in group A (oral 5 days, intravenous 3.5 days). In group A, there was $n = 1$ patient with only intravenous application, $n = 13$ with oral, and $n = 18$ with oral and intravenous application. In group B, $n = 11$ patients received oral antibiotics and $n = 35$ oral and intravenous administration.

Table 2: Postoperative complications in groups A and B

Postoperative complications	*Group A %*	*Group A n*	*Group B %*	*Group B n*
Recurrent abscess	30.56%	11	37.83%	14
Pain	13.89%	5	5.41%	2
Osteomyelitis	8.30%	3	10.81%	4
Swelling	13.89%	5	5.41%	2
Hematoma	2.78%	1	2.70%	1
Aphthoid lesions	2.78%	1	0.00%	0
Sensation disorders	2.78 %	1	5.41%	2
Postoperative bleeding	2.78%	1	5.41%	2
Trismus	2.78%	1	2.70%	1
Hypertrophic scar	2.78%	1	0.00%	0
Secretion	5.56%	2	5.41%	2
Wound healing disorders	5.56%	2	8.10%	3
Os liber	0.00%	0	2.70%	1
Myopathy	0.00%	0	5.41%	2
Nausea	2.78%	1	2.70%	1
Site infection	2.78%	1	0	0

On average, patients in group B took antibiotics orally for 2 days longer than patients in group A. Intravenous infusion of antibiotics also lasted two-and-a-half days longer in patients in group B than in group A.

Number of Days from Removal to Abscess Formation

The average number of days from removal of teeth to abscess formation was 15.07 days for group A and 20.3 days for group B (median value 20 days in group A and 7 days in group B).

Postoperative Complications after Primary Abscess Incision

Only 4.1% ($n = 5$) of patients could be treated with solely antibiotic therapy. All the remaining patients had at least one surgical intervention. The most frequent form of surgical procedure in both groups was an oral abscess incision (group A 39.2%; group B 46.5%). As the second most common procedure, an extraoral, submandibular, or temporal incision was required in 21.6% of group A and 25.4% of group B patients. In both groups, there were also eight interventions because of osteomyelitis, which led to partial resection of the mandible ($n = 3$), local sequestrectomy ($n = 3$), and reconstruction with a fibula transplant ($n = 2$). However, the highest postoperative complication in both groups was an abscess recurrence (group A 30.56%, group B 37.84%), followed in group A by pain (13.89%) and swelling (13.89%), and in group B by osteomyelitis (10.84%) and wound-healing disorder (8.11%), as seen in Table 2.

Discussion

To date, little attention has been given to postoperative manifestations of deep-tissue abscesses following wisdom tooth removal.[18] This is surprising, since in contrast to other complications such as sensitivity limitations of the IAN, osteitis, or trismus, this complication often requires hospitalization.[24–26] As a result, healthcare costs arise and it is a drastic experience for patients.[18] With regard to even more extensive complications than deep-tissue abscess, there were only a few case series or case reports on subdural empyema or angina for example.[27,28] This retrospective data analysis showed that patients with symptomatic lower 3M had more abscess events following 3M removal than those with asymptomatic ones. Although this result is not statistically significant, it fits the previously described literature. In a retrospectively designed study of Kunkel et al., $n = 45$ deep-tissue infections were analyzed over the period of 2003–2004. Of these, $n = 15$ resulted from prophylactic lower 3M removal, $n = 25$ from symptomatic removal, and $n = 15$ due to pericoronitis, of which, $n = 10$ already had a deep-tissue infection due to pericoronitis before removal.[18] The authors of the study were particularly interested in showing why the problem of such complications should not be "postponed" and why the watch-and-wait principle is not appropriate in such cases. This was further consolidated by a follow-up study, in which again these three groups (prophylactic $n = 27$, symptomatic $n = 44$, and acute deep-tissue infection due to pericoronitis $n = 29$) were analyzed in the period of 2003–2006.[17] In a total of 100 patients, 80 developed deep-tissue abscesses with a mean hospital stay of 7.3 days and disability from work of 16.3 days. There was no significant difference found among the three groups; however, those in the symptomatic group tended to be disabled from work for longer. Thus, it is concluded that the higher burden arises from the removal of symptomatic lower 3M than prophylactic removal.[17,18]

The "watch and wait principle" of 3M is based on the changing conditions due to increasing age, which is associated with reduced elasticity of the bone, hypercementosis, and reduced wound-healing capacity.[1] However, in the previously described study, age was not included as a factor, it was only stated that the complication rate increased from the 4th decade on, since 20% of the total complications were observed in patients >50 years.[17] In our study, patients in the group with symptomatic 3M were also significantly older by 11.37 years (mean 37.82 years). Older age was also correlated with more surgical interventions for abscess treatment, but this was independent of group affiliation. In contrast, the younger patients in our patient population had significantly more pain.

In a study in 2014, examining complication rates after removal of 1.199 lower 3M, there was no correlation between age or sex and sensation disorders, with an overall complication rate of 8.4% and a defined prophylactic removal at an average age of 29 years.[29] Some previous studies have observed increased complications at >25 years.[30,31] Thus, they inferred the proper time for purely prophylactic removal to be 17–24 years.[29] A recent prospective study indicated a cutoff of >35 years.[1] It should be noted, however, that the complications were mainly sensation disorders, which were all ultimately self-limited.

There are other risk factors that increase in older patients, depending solely on the increasing morbidity of the patients, such as the use of anticoagulants, greater bone atrophy with the associated risk of fracture, or longer operating times due to ankylosis of the impacted teeth. This has also been appropriately documented and is consistent with our results.[16] In our patient population, there were significantly more patients with cardiovascular diseases, and the correlation of more surgical procedures to those with neurological diseases increased. However, this cannot be considered solely in favor of early prophylactic removal. Studies have shown that the lower the stage of tooth formation (Nolla stage) is, the higher the risk of developing delayed-onset infection (DOI).[32] The explanation

for this may lie in the deeper impaction of the tooth and in the full soft-tissue coverage. It is assumed that there is only one way for bacteria to migrate deep under the mucosa and no way out.[33,34] Thus, the probability of the occurrence of DOI in younger patients with low Nolla stages of teeth is higher.[32,35] Delayed-onset infection usually occurs in 66% of patients between 12–24 years and 15–60 days after 3M removal.[7] In our patient population, the average time to abscess formation was 20 days in the prophylactic removal group and 7 days in the symptomatic removal group.

The position of the lower 3M in particular also plays a major role. For the positional relationship, the Pell–Gregory classification combined with the Winter classification is commonly used to describe the position and angulation of the teeth for predicting the difficulty of extraction and is based on their spatial relationship to the ascending ramus of the mandible and occlusal plane. Here, a recent multicenter study with a total of 1826 lower 3M in 20 centers found that there were significantly more complications (10% total) when the tooth was class IIB of the Pell–Gregory classification. Within our study, no significant difference could be observed. Perioperative administration of antibiotics to prevent inflammatory complications like abscess or DOI is also still discussed controversially. An additional benefit is not described for postoperative application, it has at best described improved effect in healthy patients as preoperative application.[1,36] In our study, the application of an antibiotic was on average continued for 2 days longer in the group with symptomatic teeth. Nevertheless, 8 patients postoperatively developed osteomyelitis with necessary partial jaw resection and reconstruction by means of fibula grafts ($n = 2$). Moreover, the rate of recurrent abscesses despite postoperative antibiosis was 37.84% in the group with symptomatic teeth vs. 30.54% in group A. Therefore, the administration of antibiotics must continue to be critically evaluated. There are shortcomings of this study that need to be discussed. First, due to the retrospective study design, there were discrepancies between the groups in terms of group size and composition. Due to the small sample size and discrepancies, and without strict methodology and the evaluation of the influence of other factors on postoperative complications, the conclusions cannot be fully supported by the presented results. Moreover, there is a high group selection bias because patients were only generally selected for abscesses, and their radiographs and clinical findings were analyzed afterward. Furthermore, due to the fact that after the removal of 3Ms in the maxilla postoperative sequelae such as pain, swelling, and trismus that have different incidence, these were extracted from evaluation. However, the specific surgical technique of removal of the teeth as well as the duration of the operation were not considered separately, which also creates a bias. In addition, due to the recruitment of the patients, many different surgeons with different levels of experience were involved, which also creates bias. Therefore, the results obtained here should be evaluated with caution, since the prognosis or the development of complications is significantly dependent on many different factors. Local factors such as localization of the tooth, relation to adjacent teeth, and anatomical structures. Systemic factors such as the presence of diseases that impair wound healing, e.g., diabetes or existing habits, skills of the surgeon, which influence the duration and extent of the operation, as well as adjuvant therapy, e.g., antibiotic prophylaxis.

However, the problem of the predictability of potential pathologies of 3M remains. Based on the classifications for 3M and the data that clearly suggest more serious problems (abscesses and especially hospitalization) in already symptomatic teeth at a higher age, prophylactic removal at a younger age is supported. However, prophylactically extracted teeth with a lower development stage also lead to more serious complications (DOI). Thus, "prophylactic" removal should be performed only at advanced root development and up to an age of approximately 25 years. To detect potential pathologies at an early stage, regular clinical and radiographic examinations should be performed, and the indication for removal should be given at an early stage of pathology despite advancing age.

Conclusions

Within this patient population and caution of the interpretation of these results because of the study design and other factors discussed, however, postoperative abscesses occurred more frequently after the removal of symptomatic lower 3M, without correlation to the localization of the teeth.

Clinical Significance

Despite the retrospective character of this study with the correspondingly described limitation above, this type of surgery is and remains the main activity in the daily routine of the oral surgeon. Therefore, a sufficient evaluation and indication of the removal with regard to possible serious consequences of a deep tissue abscess is required.

Author's Contributions

Conceptualization: AW and MB; Methodology: AW and MB; Software: AW and WA; Validation: AW, CF, JF, and MB; Formal analysis: AW, JF, and CF; Investigation: AW; Resources: MK; Data curation: MK; Writing – Original Draft Preparation: JF, CF, and MB; Writing – Review and Editing: AR; Visualization: JF and CF; Supervision: MB and AR; and Project administration: MK; Funding acquisition: MK.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee of the medical faculties of the Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany (177_19Bc).

Informed Consent Statement

Informed consent was obtained at the first visit in regular forms of the institute (by signing the anamnesis sheets) from all subjects involved in the study.

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