Faculteit der Diergeneeskunde

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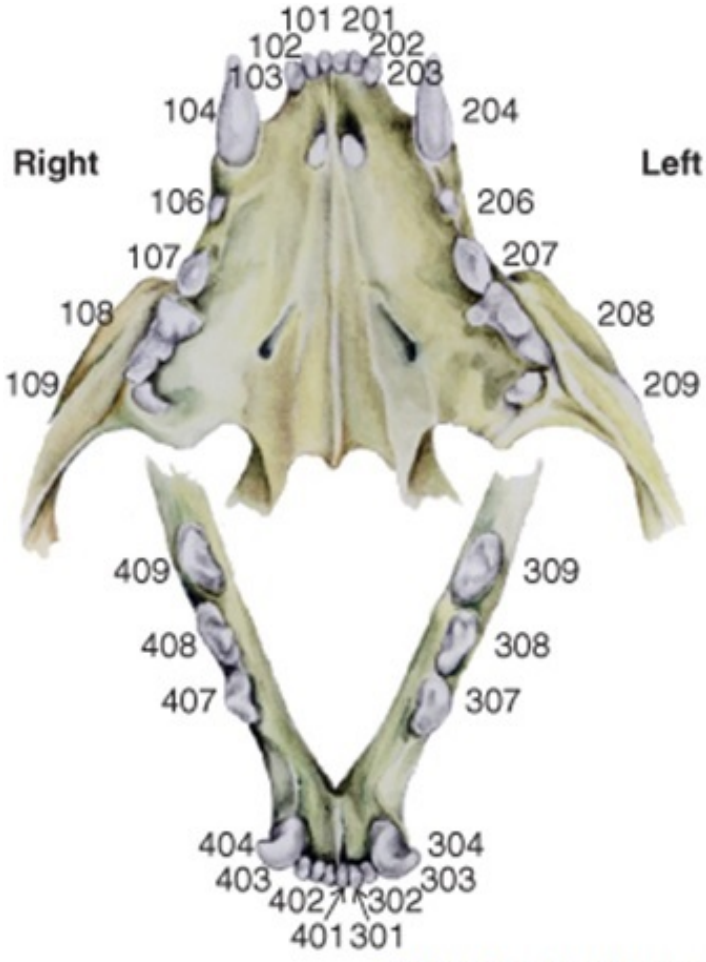
Stress as a main contributor to FCGS and TR, plausible?



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Stress as a main contributor to FCGS and TR, plausible?

Objective: To compare stress indicators in cats with and without TR and/or FCGS before their onset.

Design: Retrospective case-control study with a prospective control group.

Animals: 31 cats diagnosed with FCGS, 38 cats diagnosed with TR and 24 cats with no dental problems

Procedures: Through comparison of completed surveys between the dental diseased groups and the control group, differences in means were investigated. The control group were clinical and radiographic examined before they were allowed in the control group.

Results: 18 significant values passed the Bonferroni correction. These values shows a tendency of discrepancy in social desirable behavior before onset of FCGS and TR, including higher estimated stress and pain levels.

Conclusions: This study did not find convincing evidence that cats in the Netherlands with FCGS and/or TR were subjected in the past to more stress than cats without these dental conditions. Although there is a tendency of social desirable discrepancy before onset of TR and FCGS, which could be related to household-stress.

F.W. van Aerde January 2016, Utrecht

Introduction

Feline chronic gingivostomatitis (FCGS) is a very severe and painful dental condition. This condition describes an inflammation of the gingiva and oral mucosa of cats. Due to the painfulness of the condition, some cats are deliberately refusing to eat and other symptoms such as halitosis (bad breath), ptyalisme (increased saliva production), weight loss and mood changes can occur. These mood changes include dissociation and separation and/or aggression towards the owner.[1,2] FCGS is a condition in which different forms and gradations have been seen on macroscopic and histological level. This has led to different nomenclature. The following names are examples of FCGS: Lymphoplasmacytic stomatitis (LPS), lymphocytic plasmacytic gingivitis stomatitis (LPGS), plasmacytic stomatitis (PS), chronic ulcerative paradental stomatitis (CUPS), plasma cell gingivitis stomatitis-pharyngitis, chronic ulcerative stomatitis, necrotizing stomatitis and chronic gingivitis-stomatitis–faucitis.[3] A more recent way to allocate FCGS has been suggested by Hennet et all.[4] Hennet suggest to divide FCGS according to its location. Examples are caudal stomatitis and alveoloar-buccal mucositis.[4] The most recognizable lesions are bilateral erythematous, ulcerative and/or proliferative lesions of the gingiva, lips, buccal mucosa, palatal mucosa, tongue and the pharynx.[2,5]

The histopathology of FCGS is characterized by an infiltration of primarily plasma cells. Besides the predominantly plasmacytic infiltration, macrophages, lymphocytes and neutrophils are frequently seen in the inflamed oral tissues.[1,3]

FCGS is a condition which is seen in several breeds. Especially in the Abyssinian, Persian, Burmese, Himalayan and the Maine coon. Hence, there is a strong suspicion that genetics plays a significant part in the development of this condition. However there isn't scientific evidence to support this theory.[1,2]

The prevalence of FCGS is not fully elucidated, but thought to be fairly common.[6] In 1986 Frost and Williams reported that 62% of the questioned veterinarians, affiliated with the American Dental Society, diagnosed gingivostomatitis at least once a week.[7] A more recent study has been performed by Healey et all.[6] In 2007 Healey investigated the prevalence of FCGS in primary practices surrounding Liverpool (Britain) over a period of 12 weeks. This research showed that 0.7% of the 4858 cats seen in primary practice had FCGS[6]. Considering that most of the 4858 cats were not offered for dental problems could explain the difference between the 2 reports. Therefore it can be said that FCGS is fairly commonly seen within feline dental problems.

Despite of the clinical signs and the moderate frequency in which this condition is seen, the etiology of FCGS is yet poorly understood. Therefore a lot of research has been done on this topic. It's been thought that an infectious component as well as an immune-

mediated component plays a part in the development of FCGS.[1-3,8]

For the infectious component a viral and a bacterial role are described in the development of FCGS. However there hasn't been any evidenced based reports describing feline viruses, such as feline infectious peritonitis (FIP), feline leukemia virus (FeLV) and feline herpes virus (FHV) as sole cause of FCGS.[2,5,9] Several studies have described that feline calicivirus (FCV) is seen significantly more often in cats with FCGS than in cats without FCGS.[1,4,5,10] Lommer et all[5] detected a prevalence of 88% of FCV in cats with FCGS and Dolieslager et all[1] reported a prevalence of 71% of FCV in cats with FCGS. The prevalence of FCV seen in the control groups of the previously mentioned studies were respectively 21% and 13.3%.[1,5] Thus, an experimentally induced or naturally occurring FCV infection does not necessarily result in a chronic oral inflammation.[9] Lommer et all also detected that all FCGS cats shedding FCV were shedding FHV-1.[5]
Bacteria present in plaque fulfill a significant role in the development of FCGS. Their role will be explained in more detail in the section Dental plaque.

There is no satisfying treatment for FCGS. Medical treatment with corticosteroids or interferon doesn't result in full remission.[2,4] Despite the fact that the use of long-acting corticosteroids will decrease the symptoms for a short period of time, the usage of corticosteroids is not recommended. In the long term the efficiency of corticosteroids will decrease and there will be recidivism. In addition, the usage of corticosteroids can also induce diabetes mellitus, polydipsea, polyuria, behavior changes and thinning of the skin.[11-13] The use of interferon is also not recommended. Besides the high cost, the effect can be considered doubtful.[4]

The primary treatment is surgical intervention which includes extracting the teeth with inflamed gingiva. Within 2 years after extracting the teeth, 80% of the cats is expected to have a non-inflamed mucosa.[2] It is unknown if these cats were supported with medications after extractions. Given the rigorous therapy, it would be ideal if there's a possibility to prevent the development of FCGS. This would save much inconvenience for the feline population.

Tooth resorption

Tooth resorption (TR) is a frequently seen dental problem in cats and in which an inflammatory component is involved. In the primary care clinics 25-75% of all cats with dental problems are diagnosed with TR.[2,14] TR results in tooth deterioration through resorption of tooth substance. The resorption can be localized supragingival and/or subgingival.[15] The resorption can expand to large lesions of the tooth. This weakens the tooth, making it vulnerable for fracture.[16] The lesions are seen on the buccal and the lingual side of the tooth. Tooth resorption on the buccal side is seen more often.[9] Symptoms which are associated with supragingival lesions are pain, ptyalism, anorexia and adipsia. Subgingival lesions on the other hand can be asymptomatic. A radiographic examination has to be performed to see the lesion to its full extent.[15] Tooth resorption is not a new condition. Before the denomination TR was passed by the American Veterinary Dental College (AVDC) and the European Veterinary Dental College (EVDC), this condition was also known as feline odontoclastic resorptive lesions (FORL) and resorptive lesions (RL).[15]

Similar to FCGS, the etiology and pathophysiology of TR is poorly understood. Perhaps FCGS and TR share certain similarities in their etiology. Because the pathophysiology of TR is unknown, multiple theories are present on its pathogenesis. One theory concludes the suspicion that the resorption is being initiated by an abnormal immune-mediated reaction of the cat on the byproducts of the bacteria, which can be found in plaque. The cytokines which are released by a local inflammation can stimulate (indirectly) the formation and activity of odontoclasts.[17] Odontoclasts are cells which resorb dentine. In terms of function the odontoclast are thought to be similar to osteoclasts.[18] In case of a chronic stimulation of odontoclasts, the resorption of dentine will be significant, leading to tooth deterioration. Other plausible theories includes, hypervitaminosis A[19,20], mechanical stress[21], a viral infection[22], wrong dietary texture[2,23] and hyperparathyroidie.[15]

A radiographic examination is vital to evaluate the severity of TR in any patient. A general dental examination can yield much information, but can also be misleading. An optic, tactile healthy tooth can nonetheless be subjected to dentine resorption. A radiographic examination provides information

on the extent to which the tooth is deteriorated, including the tooth roots. To describe the extent of the deterioration, on clinical and radiographic level, a classification has been made. The different stages are described in figure 1.[15,24]

Stage	Classification of clinical stages
1	Lesion only in cementum or cementum and enamel
2	Lesion through the cementum/enamel into the dentin, which will not extend to the pulp cavity.
3	Lesion through the dentin into the pulp cavity. Most of the tooth retains its integrity
4	Extensive structural damage of tooth substance. Most of the tooth has lost its integrity
5a	Crown lost, extensive root destruction
5b	Crown (partly) intact, extensive root destruction.

Fig.1 TR stages

The treatment of TR consist of extracting the affected tooth. A possible complication during any extraction is a fracture of the tooth. TR affected teeth can be brittle, due to its low integrity. This means that these teeth will fracture easily during the extraction. Another condition that could make the extraction complicated is ankyloses of the tooth roots, in which the tooth roots has fused with the adjacent alveolar bone. Healthy teeth are being separated with alveolar bone by the periodontal ligament. In case of ankyloses the periodontal ligament lacks normal fibrous architecture. The tooth roots and the alveolar bone tissue will have direct contact.[25] Due to bone modulation, the whole tooth can be eventually be replaced by bone tissue. This is called replacement resorption.[15,25]

Dental plaque

Dental plaque harbors a variety of bacteria, which give rise to gingivitis and periodontitis. The bacteria found in the dental plaque and in the oral flora of the cat are: Streptococcus, Staphyloccocus, Pasteurella, Fusobacterium, Porphyromonas gingivalis and Tannerella forsythia.[15,26,27] Not only the inflammatory reaction but also the immune response of the cat against the byproducts of these bacteria plays a significant role in the development of FCGS and TR.[1,2,28]

Depending on the bacterial load in plaque and/or the ability of the cat's immune system to responds adequately, an mild to severe inflammation of the gingiva or periodontium can occur. This will recruit plasma cells, macrophages and lymphocytes.[3,15,29] Due to the continuous exposure to bacterial byproducts, a chronic inflammation will develop. A chronic inflammation will stimulate and recruit a large number of odontoclasts. This recruitment will lead to dentine resorption.[9,16] The severity of the immune response and the exposure to bacterial byproducts, are essential for the development of FCGS and TR.[2]

As previously mentioned the etiology of both dental conditions are poorly understood. Perhaps FCGS and TR share certain similarities in their etiology. A better understanding of their etiology can hopefully lead to preventive measures and lower the prevalence of these dental conditions. Swiss researchers have been studying the role of stress in the development of FCGS and TR.[27] In this retrospective research cats were studied in which amount they were subjected to stress, before they developed the dental condition. The immunosuppressant effect of stress can perhaps be a contributor to the development of FCGS and TR. However the extent to which stress plays a role in the development of FCGS and TR in cats is yet unknown. Cats can be exposed to a lot of stressors in the modern household. Examples of stressors are a high cat density/population, a restriction in/on natural behavior and any changes made in their environment.[16,30] The following research was conducted to reveal if cats diagnosed with FCGS or TR were subjected to more stress than cats without FCGS or TR.

Material and Method

Subjects

31 cats with FCGS and 38 cats with TR were enrolled in this study. These cats were diagnosed at the University Clinic for Companion Animals in Utrecht between the year 2004 and 2014. Both groups included seven cats which were diagnosed with FCGS as well as TR. Due to the potential similarities in the etiology of FCGS and TR and their differences in etiology, several groups were formed. Figure 2 illustrates the several groups, including the group size. The dental inflammatory group (DIG) consist of all the enrolled diseased cats. The pure group consists of cats with solely the named disease. The all groups consists of all the cats with the named diseased, including the multiple diseased cats. Every group has been used for statistical analysis.

The control group was formed by 24 cats. Details concerning age, sexes and breed distribution of every group have been placed in appendix IV.

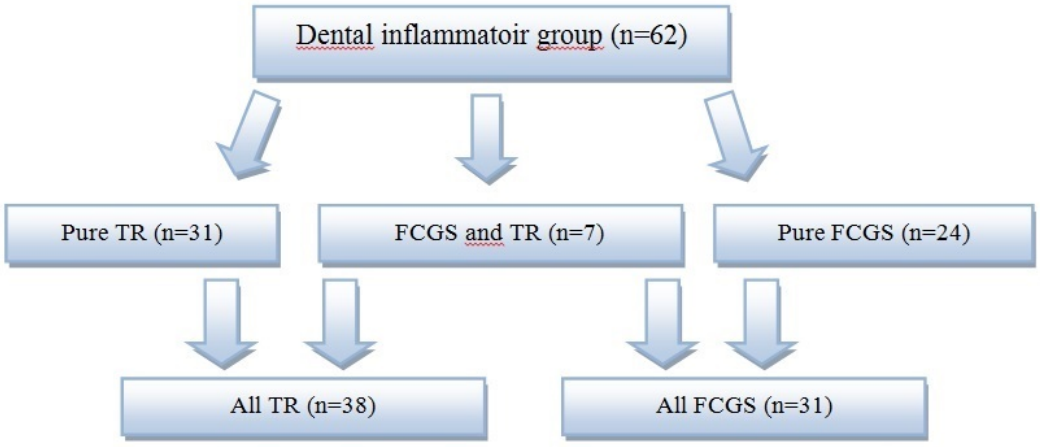

Fig 2. Overview of the 6 diseased groups

The following pure breeds were enrolled for the diseased or the control group; British and European shorthair, Burmese, Cornish Rex, Norwegian forest cat, Maine Coon, Persian, Siamese and the Tonkinees.

Proceeding

In this retrospective case-control study, the owners were contacted to complete a survey. The survey was based upon a survey which Swiss researchers have used for a similar study.[27] The Swiss survey was extended by additional questions and some adjustments were made to suite the survey for Dutch conditions. The survey contained 89 questions on the following subjects: the social structure of the household, the social surroundings including the behavior of the cat within these surroundings, the general animal health, the ability to express animal instinct and the manner of care taking by the owner. All the questions had to be answered suiting the situation before the clinical symptoms occurred. The questionnaire has been added to the appendix III. The questionnaire could be completed digitally or in writing. More details on this part of the proceeding can be found in appendix I and III.

The control group is a prospective case-control group. Owners of ASA 1 and 2 cats which were offered for anesthesia in the University Clinic for Companion Animals in Utrecht during the period of December 2014 and January 2015, were asked if they would be willing to participate in this research. If the owner agreed, an informed consent was signed. This approval form can be found in appendix II. By signing the approval form, the owner gave permission to subject the cat to an oral and a dental radiographic examination. At the oral examination the cats were checked for signs of FCGS and TR, by examining the mouth in general and the elements, gingiva and the palatoglossal folds in particular. This was done under general sedation or just before intubation. Clinical pictures were made of the oral condition, to save the clinical dental condition at that moment, in case a second judgement was needed. Examples of these pictures are placed in appendix V. If the oral examination showed no significant indication of inflammation or other diseased dental conditions, the cat was subjected to a radiographic examination of the teeth 307 and 407. According to Heaton, the teeth 307 and 407 are the prominent onset places for TR.[31] For the radiographic examination a mobile Xraymachine was used with the settings 65kV and 0.26 mAS. A Dürr dental phosphor plate was used to capture the image. The dental radiographs were evaluated on the presence for tooth resorption. Depending on the result of the radiographic examination, the cat was placed in the control group or in the TR group. Because this screening included cats in good general oral health, TR lesions were not expected in advance. However, through this radiographic screening it was noticed that 2 potential control cats had TR. Therefore these 2 cats were placed in the Pure TR group. Footage and more details of the radiographic examination have been placed in appendix VI. The same survey was used for the control group as for the diseased groups. The control group has been used for TR for FCGS.

Statistical analysis

Comparison between the diseased and the control group were made through the data from the questionnaire. Due to the variety of questions, the nature of the questions differ. This has led to different types of variables and thus different levels of measurement. Depending on the nature of the question, a nominal, ordinal or continuous scale-based distribution was indicated. The data given on every question was evaluated through a statistic test, such as a Chi-square test, a Kruskall-Wallis, a Mann-Whitney test or a Student T-test. The chi-square test was used for the nominal distributed

answers, the Kruskall-Wallis and the Mann-Whitney in case of ordinal distributed answers and the Student T-test in case of a continuous scale-based answer. When required, the Chi-square test was followed by the Fisher exact test. A P<0,05 was considered as significant for all comparisons made with the 3 given tests and the outcome of the exact 2 sided significance was considered as valid. All found significant values are placed in the appendix VII.

First the dental inflammatory group(n=62) was compared to the control group(n=24). To see if stress has any influence on a cat which was affected by TR and/or FCGS. If a significance was found, the strength of the significance was calculated using the φ and Cramer's V (nominal distribution). Figure 3 was used to interpret the values of Cramer's V and φ.[32]

Value φ / V	Strength correlation
0-0.1	No correlation / very limited
0.1-0.3	(very) weak correlation
0.3-0.5	Moderate/ relative strong correlation
0.5-0.7	Strong correlation
>0.7	Very strong correlation
1	Fully coherent

Fig.3 Interpretation Cramer's V and φ

The precise calculated p-value was subjected to a Bonferroni correction. The Bonferroni correction lowers the change of a type 1 error, by adjusting the p-value for the times a static test was performed. The considered significant p-value of 0.05 was divided through the total number of questions, which were subjected to a statistic test. Thus, any significance with a p-value below 0,00056 (0.05/89 questions) was considered as significant.

Secondly; the groups Pure TR, FCGS and TR and the group Pure FCGS were compared to the control group. By calculating the p-value per question for all three groups at once, the change of an type 1 error will decrease, in comparison with calculating the p value for each group separately, multiplying the total number of calculations with 3. After the calculation, a post hoc testing was performed. The adjust z score was used for the Chi-square test and a Mann-Whitney for the Kruskall-Wallis. The strength of the significance was calculated through the φ and Cramer's V association (nominal distribution). The found p-values are subjected in the similar way as for the dental inflammatory group(DIG) to a Bonferroni correction.

Finally the same procedure for the groups Pure TR, Pure FCGS and TR + FCGS was done with the groups ALL FCGS and ALL TR.

Results

The 89 questions from the survey have been placed in 5 categories: household structure, social interaction, movement and instinct behavior, clinical health and care taking. This was done to create a more distinct overview of the results and has no influence on the outcome. All found significant values are placed in appendix VII . Only the p-values which were still valid after the Bonferroni correction are mentioned below.

The household structure

The household structure contains the specifications of the household and the specifications of the cat, including its history. Specifications such as breed, age and gender of the cat and previous caretakers (shelter, breeder), but also the number of adults and children in the household, including recent changes.

As seen in Appendix VII, there are no significance found in this category. Initially, it seemed that a significance was seen for the groups Pure TR, Pure FCGS, FCGS+TR, All TR and All FCGS to have stayed more often in a shelter than the control group. However, after the post hoc testing, there was no significance found. There was also no significance found in occurrences between crossbreeds and pure breeds.

The social interaction

This category looks at the social behavior of the cat towards humans, conspecifics and other animals. The social behavior has been investigated by questions concerning topics such as aggression, anxiety, washing and playfulness.

Cats of the dental inflammatory group play significant less with conspecifics (p=0.00046) than cats in the control group. With a φ of 0.4 this significance is relative strong correlated. Almost the same can be said for the group All TR. The group All TR was very close (p=0.00066), but due to the Bonferroni correction, this is not considered as a valid significance.

The cats of the control group tends to play more in general than the other groups. As shown in appendix VII, cats in the control group play significantly more with humans than the DIG and

the Pure FCGS group, respectively p=0.00022 and p=0.00002.
Besides the playfulness of the control group, other significant deviations were also found in the social interaction. The cats in the Pure TR and All TR group are significant more aggressive towards conspecifics in comparison with the control group, respectively p=0.00016 and p=0.00022.
Cats in the groups FCGS+TR and All FCGS are less fond of being stroked by the owner than the control group, respectively p=0.00001 and p=0.0000. This also counts for being stroked by strangers, in case of the All FCGS group p=0.00000.
Pure TR cats tends to be more anxious towards other conspecifics but did not pass the Bonferroni correction (p=0.00105).

The movement and instinct behavior

This category includes the roaming behavior of the cat. Is the cat exclusively indoors or may it roam outdoors and to which extent does the cat roam, including any hunting activity.
It appears that cats in the groups FCGS+TR and All FCGS are significantly less fond of laying in the windowsill, respectively p=0.00046 and p=0.00000. Also a tendency has been found for the group All FCGS to walk more on the neighbors rooftop than the control group. No significance was found for climbing and walking on their own rooftops.

Clinical health

This category includes the clinical health situation of the cat. This topic covers items such as chronic defecation, urinary, emetic and skin problems, but also estimated pain and stress levels.
The cat owners of the group DIG, Pure FCGS, FCGS+TR and All FCGS estimates significant higher pain levels before onset than the control group, respectively p=0.00005, p=0.00002, p=0.00005 and p=0.00000. The All TR group did not make the Bonferroni correction with a p-value of 0.00079.
The control group is significantly more dewormed per year than the groups DIG, Pure TR, Pure FCGS, All TR and All FCGS, respectively p=0.00000, p=0.00000, p=0.00001, p=0.00000 and p=0.00001.
In general the cat owners for all the 6 dental diseased groups estimates higher stress level before the onset than the cat owners of the control group, but after a Bonferonni correction no significant values were found.

Care taking

This category contains components about the general care taking of the owner. For example, how many litterboxes, water and feeding bowls are there? How frequent and how long is the cat alone? Are there non-disturbance areas? Are the teeth of the cat been brushed?
A significance has been found in the frequency of changing the cat's brand of food. The control group appears to be subjected to more frequent change of foodbrand, than the group DIG and Pure TR, respectively p=0.00040 and p=0.00031.

Discussion

Due to the retrospective nature of this study, an subjective method was used for measuring stress parameters of the diseased group, before the onset of the dental conditions. An objective method for measuring stress can be the parameter cortisol, if taken in a stress free manner. Due to the retrospective nature of this study design, the cortisol levels are unknown. An alternative study design is to measure blood cortisol levels on a frequent base in a big group of cats, in the assumption that at a certain point the onset of FCGS and TR will occur in some cats. Executing this study design would take several years and the assurance of withdrawing blood over a longer period of time without causing stress is doubtful. Furthermore it must be carefully considered whether the expected results would compensate the animal restraint. However a long-term prospective study, including the measurement of cortisol levels through cat hairs could be feasible and includes less animal harm.[33]
This study was designed as a retrospective study. The main disadvantages of this study are the large numbers of potential stress factors and the potential dis-ability of the owner to remember the situation before onset correctly. The estimation of the stress exposure relies solely on the given answers of the owners, including their perception on the given situations. It is to be expected that the memory of the owner is colored and blurred, considering the large period between the onset and the survey.
Considering the possibility of owners confusing the diseased cats with other cats in their household or

be ashamed of their own caretaking, most surveys were held in direct contact with the owner, with the intention to reduce these factors. A few questionnaires were held through a survey website. If the direct contact with the owner has acutely let to a reduction is unknown.
The formation of the control group depended on the supply of ASA 1 and 2 cats which were offered to the University Clinic for Companion Animals in Utrecht, within the duration of this research. During the duration of this research a large group of cats were offered to the clinic for gonadectomy, which influences the mean and median age of the control group. The age range of the control group is wide (6m – 15y), but the median indicates that a large percentage of the group were young cats. With a median of 8.5 months and a mean of 2 years and 10 months it can be questioned if these cats have encountered enough stressors and if the opportunity window has been wide enough for TR and FCGS to develop. Therefore it is questionable if these cats will remain TR and FCGS free and if the given answers by their owners are suitable for this research. Development of TR can't be excluded in this study, since TR has a prevalence of 66,7% in cats older than 4 years months.[14] The prevalence of FCGS is not fully elucidated but also the development of FCGS can't be excluded, because it seems to occur more prominently in cats aged 1-5 years and 10-13 years old.[6]
The exact age at which the onset of FCGS and of TR can appear has not been determined, as far as the author is aware. A brief look in the literature results in the following ages. Healey[6] has reported a FCGS cat younger than 1 year and Ingham[34] has reported a cat of 2 years old with TR.
The prevalence of TR increases with age. Besides old age, it is thought that other risk factor also contributes to the prevalence of TR. These risk factors are: being an exclusively indoor cat, a city residence, a female, less playful with toys, drinking city water, hereditary and dietary composition[35-37].
A suspicion has been reported of TR in a 8 months old Maine Coon at the University Clinic for Companion Animals in Utrecht in 2005. The youngest reported age for a cat with TR, besides the suspicion of TR in the 8 months year old Maine Coon, is 31 months old at the University Clinic for Companion Animals in Utrecht. The youngest FCGS patient reported at the University Clinic for Companion Animals in Utrecht was 9 months old over the period of 2004-2014.
The low mean age of the control group can potentially have influenced the results. Young adolescence animals tend to be more reckless and playful in general than elder animals. In addition, cats within their first year also receives more deworming tablets than older cats. To which extent this has influenced the results is unknown.
The mean age of the control group is an improvement point for this paper and should be a taken into account for other studies.
The significant p-values after the Bonferroni correction, show a tendency of less social interaction of the dental diseased groups. The dental diseased cats tend to be less playful and to be more aggressive towards conspecifics. In addition, the dental diseased cats, especially the FCGS cats, appear to be subjected to more pain, according to the pain estimations of the owners.
It is to be questioned, if the pain is truly been seen before the onset of the dental disease and is not directly related to the dental condition. It can't be expected from the owner to notice a starting inflammation of the gingiva and oral mucosa. A solution could have been to accompany the question with an additional statement that the pain estimation should not apply for any pain which originates from the mouth. However it is questionable if every owner can differentiate pain originating from the mouth from other locations.

It is remarkable that all 6 dental diseased groups have a significant higher estimated stress level and none of the 6 groups passed the Bonferroni correction. The question which follows after the stress estimation was how frequent the stress has been seen in the cat during the week. This last question has been left out of the results, due to a discrepancy. Of the 50 owners who answered to see some stress levels within the cat, 16 owners could not tell how often that would be during the week. This has led for this particular question to a control group of n=4. Therefore this questions was discarded, despite the fact that some owners with a dental diseased cat estimated high frequencies of stress during the week and a significance (P=0.00878) was found between the DIG and the control group
Besides the stress estimation of the owner, there were also some less obvious questions, which can indicate submission of chronic stress. 4 examples

of less obvious questions, which can indicated chronic stress submission are discussed below:

- The question on how many water bowls and feeding bowls are present in the household should be placed in perspective and should be correlated for the number of cats within the household. If there are more cats than water or feeding bowls, than it could be a distress factor. Unfortunately, this correlation could not be calculated in this study.
- Checking the hairs on the abdomen, can be an indication if cats can cope with chronic stress. If there is alopecia of the abdomen, it can be due to obsessively licking of the abdomen, which can be a sign of redirection behavior.[38] Alopecia of the abdomen has been seen with 5 dental diseased cats.
- Frequent changing of dietary can be seen as an stressor. It is odd to see that the control group is significantly more subjected to these changes than the dental diseased groups. Unfortunately, there is no association value calculated for the ordinal distributed questions and therefore it is unknown how strong this significant variation is. The reason for not adding the association values for the ordinal distributed questions, is given in the epilogue.
- General anxiety for other animals and/or humans which live in the same household has to be considered as a huge stressor. In households, in which also a dog was present, no significant different relationship was found between the 2 animals. The fear of other conspecifics has been seen significantly more often in the diseased dental groups, but did not make the Bonferroni correction.

Perhaps not surprising but certainly disappointing is the extent in which the cat's teeth aren't cleaned by the cat owners, irrespectively to which group they're from. 10.5% of all the participating owners brushes the teeth of their cat.

The FCGS+TR group was made to purify the Pure FCGS and the Pure TR group. Because the FCGS+TR is a very small group, the possibility of finding a significance value by change increases. It is typical that this group was very reluctant for being stroked and petted by the owner, while the p-value for the groups Pure FCGS(p=0.57) and Pure TR(p=0.38) are not near any significance. The influence of the FCGS+TR group is clearly seen, when comparing the p-values of this question of the groups Pure FCGS (p=0.57) and All FCGS (p=0.00000). Due to this oddness, it is questionable how strong this significance is. This also counts for the question if the cat likes to lay in the windowsill. Perhaps the dental diseased cats are more restless and therefore are less likely to lay in the windowsill. This could apply but only FCGS+TR and All FCGS passed the Bonferroni correction.

The change of a statistical error 1 type is realistic, considering the high amount of questions in the survey. The change of an error 1 type is 5%. This means that four out of the 88 questions should be consider as an erroneous significant value. To lower the changes of a type 1 error, the Bonferroni assessment has been used. The Bonferroni lowers the considered significant p-value to 0.0005. By using this very low p-value, there has been corrected for more than the previous assumed 4 erroneous questions. This correction has resulted in devaluating 41 previous measured significances and also in objecting 12 questions in which to some extent a significant p-value was found. Every p-value found before the Bonferroni are placed in appendix VII, accompanied with the question and the group they relate to. This has been done, to empower and show the tendency of stressors and behavioral discrepancies of the dental diseased groups. Perhaps the Bonferroni, due to it harsh correction, has devaluated to much statistical significances. In appendix VII there is an overall tendency to be seen of less social interaction by the dental diseased groups. This is shown through the questions which covers household disturbance, anxiety and aggression towards conspecifics. There is also a tendency seen of general discomfort of the dental diseased groups through the pain and stress estimations by the owners.

In comparison with the early results of Koch[27], there are some interesting similarities and differences. There are similarities in the social character of the cat. During the non-clinical onset of the diseased group, the cats tend to be more aggressive towards conspecifics, less likely to play with and be more anxious towards conspecifics. Although this research does not provide a post hoc significant value for FCGS cats to behave more

aggressive towards other cats and to play less with conspecifics, the mean values are higher in comparison with the control group.
The results of Koch suggests that FCGS and TR cats are less likely to greet conspecifics, do not wash themselves in the present of other cats, urinate and defecate next to the litterbox, are fearful for dogs and hide when there are visitors present in the household. In addition, the results suggests that FCGS cats are less likely to play with humans and that TR cats are more likely to have dandruff and to be subjected more frequent to gastro-intestinal problems. This paper could not repeat and confirm these findings.
The results of this paper and of Koch[27], suggests that there is a tendency of social desirable discrepancies before the onset of FCGS and TR. This paper could not indisputably proof that dental diseased cats were more subjected to stress than dental healthy cats. Further investigation should be done, including a prospective study, in which the direct cortisol levels could be measured through the hairs of the cat.[33] Furthermore, there is also some promising development made on treating non-responsive FCGS using mesenchymal stem cells by Arzi et all.[39] Hopefully this will lead to a different approach of treating FCGS than tootheuthanasia.

Conclusion

This study did not find convincing evidence that cats in the Netherlands with FCGS or TR were subjected in the past to more stress than cats without these dental conditions.

Conflict of interest statement

The author declares that there is no conflict of interest and that this paper is the original work of the author, except where explicit reference is made to the contribution of others.

Acknowledging

My great gratitude goes to dr. H.E. Booij-Vrieling, dr. R.J. Corbee, the department of surgery, the radiology department and the anesthesia department for making this research possible.

Epilogue

During the execution of this research, several complication and inner struggles were faced. This epilogue has been created for the purpose to describe the thoughts and issues behind this article in more detail. The first obstacle was getting in touch with the owners. A certain percentage of the personal information of the owners was outdated. Of the approximately 121 potential cat owners, which represented 139 diagnosed cats, only 2 cat owners replied that they did not want to take a part of this research. 62 owners couldn't be reached, despite the efforts of calling the owners in the morning, afternoon and evening. Due to the large amount of questions of the used survey, the telephone calls had an average duration of 40minutes. Most owners were happy to spend this time on the phone, but I can image that the long duration of the telephone-call could have clouded the judgement. Due to the long telephone conversations an electronic survey was made. The link to this survey can be found in appendix III. The main surplus of the electronic survey is that the owners can fill in the questionnaire on a time it will suite them the best and the questionnaire is built in such a way, that it will not ask questions which will not apply for that specific cat owner. Example given; if you answer that you do not have a dog in the household, the questions about the relationship of the cat towards the dog will not appear on the screen. After collecting the data, I've struggled a while with translating the given answers flawlessly in such a way that it could be useful in Spss without losing specific data. This includes making the answers uniform and checking and sometimes correcting the given answers. For instance, some owners said that their cat is an indoor cat, but also comes into the yard. But this process was more an inconvenience compared with the time spend on the statistical analysis. To which extent should I correct the calculated p-values. Should I use the Bonferroni and how harsh should my correction be. By correcting for the asked 88 questions, the statically considered valid p-value will be very difficult to reach. However, the ones who do pass the correction, can be considered as strong significant values. During the calculations, I suspected an influence on the results due to the young mean age of the control group. For instance, the cats in the control group received significantly more deworming tablets per year than the dental diseased groups. It is common for cats younger than 1 year to be more frequently dewormed than cats older than 12 months. Therefore it is questionable if the significance seen on the deworming frequency is related to the development of FCGS/TR. I suspected that it is more likely that this significance illustrate the age distribution of the control group. Due to the difficulty of getting enough volume in the control group, a certain percentage of the control group derives from the gonadectomy operations. To increase the volume of elder cats in the control group, I've tried to get a primary practice to help me out. In the case they had an operation planned on a cat, which was estimated as an ASA 1 or 2 patient, they would make the dental radiographic photos. In advance the consent of the owner was asked and afterwards I would contact the owner for completing the survey. The forms and the instructions towards the veterinarian and the owners, are added in appendix VIII-X. Unfortunately, this "solution" did not lead to any addition in the control group.

To get a sense of the strength of the found p-values, I've added association values next to the found p-values. The values should stay between 0 and 1, with 0 indicating a very weak connection and 1 a very strong connection. The calculations of the Cramer's V seems to be adequate and have been correctly used for a nominal distribution. I've read in a statistical guide, Basishandboek spss 22[32], and seen online, that association values, which can be used for nominal variables also could be used for ordinal variables. This would come in ease, because the original ordinal association values are calculated through 4 different calculations: Gamma, Somers'd, Kendall's tau-b and Kendall's tau C. These 4 values give the statistician an idea of the direction and strength of the p-values, however I could not interpret these 4 values. Therefore I've chosen to use eta^2 instead. I've seen the eta^2 being calculated, during the Kruskall-Wallis test, with the purpose to know the strength of the found significant p-value. The eta^2 was calculated by using the chi-square values, which are given by spss when performing this test, and divided that number with n-1. Because this calculation depends on the size of the group, the FCGS+TR group, which consist of 7 patients, always reached a value above 1. Therefore, I've chosen to leave this association value out of the overview sheet, because I don't think these values were reliable. Upon request I could add these values to the overview.

I would like to thank dr. H.E. Booij-Vrieling for the use of her case log, the trust she has put in me by using her room including her telephone after working hours and her help in general. My gratitude also goes to the department of radiology, anesthesia and surgery for allowing me to perform this research.

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Index Appendix

Case log

By using the case logs of the dental department of the University Clinic for Companion Animals in Utrecht during the period of 2004-2013, a selection of all FCGS and TR diagnosed cats could be made. The result of this selection were 139 cats, which were owned by 121 different cat owners. The owners were called at several different moments, to enhance the change of getting in touch with them. In case the owners couldn't be reached during working hours, the owners were called during diner (18:00-21:00). Some of the owners couldn't be reached due to incorrect numbers, moving and some didn't wish to participate in this research. In the end, this has led to 62 completed questionnaires, completed by 57 different cat owners. The overview of the selection will be kept secret for privacy reasons.

Approval form (toestemmingsformulier)

To form a control group for this research, an official approval of the cat owner is needed. An approval form was given to cat owners of who's cat was planned for anesthesia at the University Clinic for Companion Animals in Utrecht. By signing this form, the owners agree to participate in this research. The signed forms were collected for administrative reasons.
To illustrate, the used approval form is attached beneath this alinea. The form was printed without this introduction and scaled to fit one a4 page.

Universiteit Utrecht

Patiënt etiket plakken

Utrecht, dd ……..
(gaarne de datum op de stippellijn invullen)

Hierbij verleen ik,

……..……
(gaarne uw naam op de stippellijn invullen)

toestemming voor röntgenologisch onderzoek bij mijn kat

……
(gaarne de naam van uw kat op de stippellijn invullen)

De genomen röntgenfoto's zullen gebruikt worden voor wetenschappelijk onderzoek naar de invloed van stress op de ontstaanswijze van gingivitis (tandvleesontsteking) en tandresorptie (tandverlies) bij de kat. Tevens stem ik in om deel te nemen aan een enquête, waarin gevraagd wordt naar de leefomstandigheden van mijn kat. De uitnodiging voor de enquête mag gestuurd worden naar het volgende emailadres.

……
(gaarne uw emailadres op de stippellijn invullen)

Handtekening

……..

Questionnaire

The questionnaire used in this research, is based on the survey which D.A. Koch has conducted. For this research 4 questionnaires were made. A paper and a digital version for the dental inflammatory group as well for the control group. The questions on all 4 questionnaires are the same. The differences lies in the introduction, the verb times in which the questions are asked, past (FCGS/TR) or present (Control) and in the ease of answering the questions (the digital option is faster than the paper version). The questionnaire following this introduction is the paper version of the dental inflammatory group. This questionnaire has been held through the telephone or send by email. The paper version of the control group was also handed out in the clinic. During the research, owners asked if an digital version was available, because it would be easier to fill in and send back. Therefore a digital version was made. The digital version can be found by following the given links.

Dental diseased: https://qtrial2014az1.az1.qualtrics.com/SE/?SID=SV_8igU856jR0dWVzD

Control group: https://qtrial2014az1.az1.qualtrics.com/SE/?SID=SV_5vtr9Aq3NuQn7DL

Ontstaanswijze van de tandheelkundige aandoeningen, stomatitis/gingivitis en tandresorptie bij de kat.

Dank u wel voor uw medewerking aan dit onderzoek. Aan de hand van deze enquête, wordt nagegaan in welke mate stress een rol speelt in de ontstaanswijze van de tandheelkundige aandoeningen stomatitis/gingivitis en tandresorptie. Op de universiteitskliniek van gezelschapsdieren te Utrecht (UKG) is minstens één van deze aandoeningen bij uw kat gediagnosticeerd.

Alle vragen die hieronder gesteld worden, gaan over de periode voorafgaande aan het gebitsprobleem. Beantwoord dan ook alle vragen naar de situatie waarin uw kat zich begaf net **voordat** de tandproblemen werden gediagnosticeerd.

U kunt de ingevulde lijst terug sturen naar het volgende e-mailadres:
F.W.vanAerde@students.uu.nl

Naam eigenaar	Reeds ingevuld door enquete-afnemer
Naam kat	Reeds ingevuld door enquete-afnemer
Geboortedatum kat	Reeds ingevuld door enquete-afnemer
Diagnose gesteld op de UKG in het jaar	Reeds ingevuld door enquete-afnemer
Hoeveel volwassenen woonden destijds in uw huishouden? Aantal:	
Hoeveel kinderen woonden destijds in uw huishouden? Aantal:	
Was er destijds over een periode van 3 jaar een nieuw familielid bijgekomen?	
Was er destijds over een periode van 3 jaar een persoon in uw huishouden weggegaan/overleden?	
Hoevaak had u visite over de vloer, 1,2,3 maal per week, of vaker?	
Komt uw kat uit een asiel, zo ja, op welke leeftijd heeft u uw kat uit het asiel gehaald?	

Heeft uw kat een verhuizing meegemaakt?	
Hoeveel katten had u destijds in huis ?	
Hoelang leven uw katten al samen?	
Zijn uw katten vertrouwt met elkaar, vriendelijk?	
Begroet uw kat andere katten met kopjes?	
Had u destijds 1 of meerdere honden thuis?	
Hoe is de verstandhouding tussen uw hond en de kat? Goed/slecht	
Heeft u naast de kat(ten) andere huisdieren?	
Is uw kat bang voor honden?	
Is uw kat bang voor andere katten?	
Is uw kat bang voor andere dieren die bij u thuis leven?	
Is uw kat bang voor onbekend bezoek?	
Is uw kat bang voor zichzelf? (Voorbeeld: bij het kijken in de spiegel)	
Houdt uw kat andere dieren in het huis in de gaten? zo ja, welke. (b.v. hamster/rat)	
Laat uw kat zich graag aaien door uzelf?	
Laat uw kat zich graag aaien door vreemden?	
Is uw kat agressief naar andere katten?	
Is u kat soms agressief naar mensen (en/of uzelf)	
Schuilt uw kat zich de hele tijd wanneer er bezoek is?	
Schuilt uw kat zich gedeeltelijk wanneer er bezoek is?	

Vindt u uw kat gestrest/ onrustig? Op een schaal van 0-10, waarbij 0 totaal ontspannen is en 10 constant gestrest.	
Hoevaak ziet u dit (de onrust) per week?	
Likt uw kat haar/zijn eigen buik schoon?	
Likt uw kat de huid schoon met andere katten in de buurt . Zo ja, met alle andere katten, of met een select gezelschap?	
Heeft uw kat een haarloze buik?	
Heeft uw kat (elders) enige kale plekken?	
Heeft u bij uw kat schilfers gezien?	
Heeft uw kat een vettige huid?	
Heeft uw kat last van jeuk?	
Heeft uw kat (andere) huidproblemen?	
Heeft uw kat pijn? Op een schaal van 0-5	
Heeft uw kat spijsverteringsproblemen?	
heeft uw kat moeite met urineren/plassen?	
Plast uw kat buiten de kattenbak?	
Heeft uw kat ooit buiten de kattenbak gepoept?	
Wordt uw kat jaarlijks gevaccineerd?	
Hoevaak wordt uw kat ontwormd?	
Is uw kat een binnenkat?	
Gaat uw kat ook naar buiten?	
Gaat uw kat de tuin in?	

Gaat uw kat voorbij de tuin?	
Gaat uw kat het dak op?	
Gaat uw kat het dak op van de buren?	
Heeft uw kat toegang tot alle kamers?	
Hoeveel vierkante meter heeft uw woning?	
Hoeveel vierkante meter mag uw kat hiervan gebruiken?	
Kan uw kat naar buiten kijken?	
Kan uw kat op een balkon? Zo ja hoeveel balkons	
Heeft uw kat een lievelingsspeeltje?	
Speelt uw kat graag met speeltjes?	
Speelt uw kat graag met soortgenoten?	
Speelt uw kat graag met mensen?	
Jaagt uw kat buitenshuis?	
Eet uw kat haar gevangen prooi?	
Hoevaak blijft uw kat/ blijven de katten alleen thuis per week?	
Hoelang blijft uw kat/ blijven de katten alleen thuis per week?	
Zit uw kat graag in de vensterbank?	
Als uw kat een andere kat voorbij het raam ziet lopen, springt deze dan weg, of blijft ze zitten?	
Krijgt uw kat alleen droog voer/brokken?	
Krijgt uw kat alleen nat voer?	

Krijgt uw kat droog en nat voer?	
Hoevaak wisselt u van voermerk?	
Staan de voer en drinkplekken bij elkaar?	
Hoeveel voerbakken zijn er?	
Hoeveel waterbakjes zijn er?	
Staat de kattenbak naast of vlakbij de voer en drinkplekken?	
Staan de kattenbakken op een vaste plaats?	
Hoeveel kattenbakken heeft u in uw woning?	
Staan de kattenbakken op verschillende plaatsen verdeeld? (bij meerdere kattenbakken)	
Staat de kattenbak beschut?	
Hoevaak per week worden de kattenbakkorrels vervangen?	
Varieert u met kattenbakkorrels?	
Maakt u de kattenbak altijd met hetzelfde schoonmaakmiddel schoon?	
Hoeveel krabpalen zijn er in uw huis?	
Waar staat de krabpaal in de kamer? centraal, hoek, balkon,tuin	
Overziet uw kat de gehele ruimte vanaf de krabpaal?	
Heeft uw kat meerdere mogelijkheden om zich ergens terug te kunnen trekken?	
Is er een "terugvalplek" waar uw kat niet gestoord wordt?	
Heeft u ooit de tandengepoetst van uw kat?	
Hoevaak per week poetst u de tanden van uw kat ?	

Staat uw kat het tandenpoetsen toe?	

Dank u wel voor het invullen van deze enquête. Zou u zo vriendelijk willen zijn om dit document per mail terug te sturen naar het volgende e-mailadres: F.W.vanAerde@students.uu.nl.

Age, sexes and breed distribution of each group

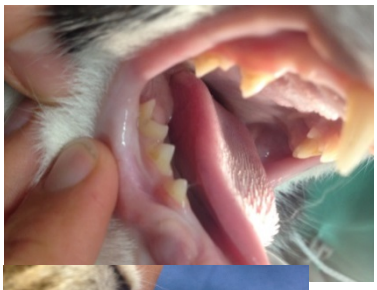
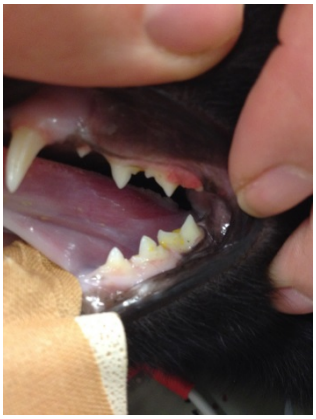
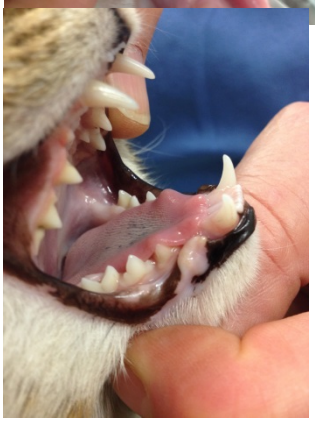
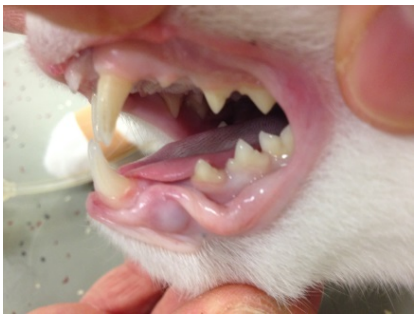
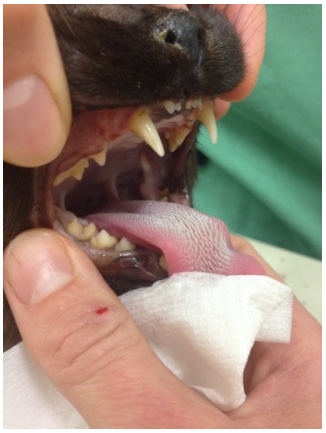
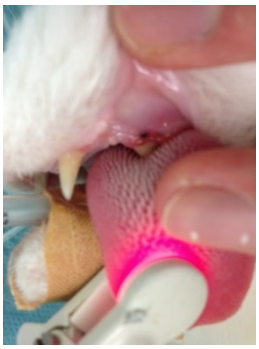
Appendix IV	Age distribution	Mean Age	Median Age	Pure Breed	Cross Breed	Tomcats (intact and castrated)	Queens (intact and spayed)
DIG (n=62)	8 months - 18 years	7 years and 3 months	7 years	55%	45%	73%	27%
Pure FCGS (n=24)	12 months -18 years	5 years and 9 months	5 years	67%	33%	83%	17%
Pure TR (n=31)	8 months - 16 years	5 years and 9 months	5 years	48%	52%	61%	39%
FCGS and TR (n=7)	2 years - 13 years	7 years and 3 months	7 years	71%	29%	86%	14%
All FCGS (n=31)	12 months - 18 years	6 years	6 years	60%	40%	84%	16%
All TR (n=38)	from 8 months and 16y	8 years	8 years	46%	54%	65%	35%
Controlgroup (n= 24)	6months - 15 years	2year and 10months	8.5 months	66.7%	33.3%	54%	46%

Oral examination

The oral examination was conducted, after the approval form was signed by the owner and when the feline was put under general sedation or anesthesia. During the oral examination the teeth, gingiva, the palatoglossal folds, and the palate were investigated for abnormalities. Pictures were made of the clinical dental situation from 2 sides by a telephone camera. This was done in the case a second judgement was needed and the photos aids with the justification of placing the feline in the dental diseased group or in the control group. The following photos were made during the oral examination and illustrates the dental condition of the felines before the radiographic examination was made.






Radiographic examination

By using the parallel technique, which is described in figure 1, the mandibular premolar and molars are projected clearly. This technique has been used to examine the 307 and 407 teeth of the control group. According to Heaton et all, the teeth 307 and 407 are the prominent onset places for TR. For the radiographic examination a mobile Xraymachine was used with the settings 65kV and 0.26 mAS. The native x-ray film was developed digitally. To give an illustration of the examination results, examples of the digital developed photos are given below. The lowest 2 photos are from a feline with tooth resorption and therefore was placed in the TR group, due to the examination.

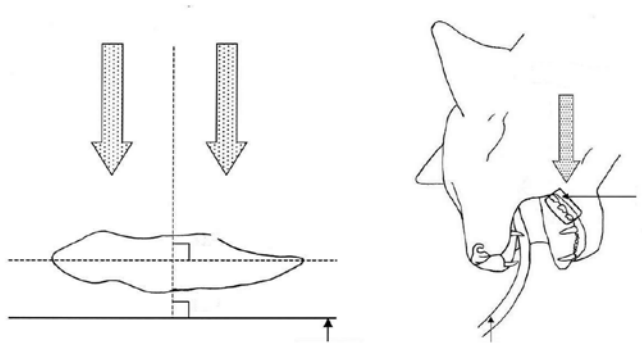
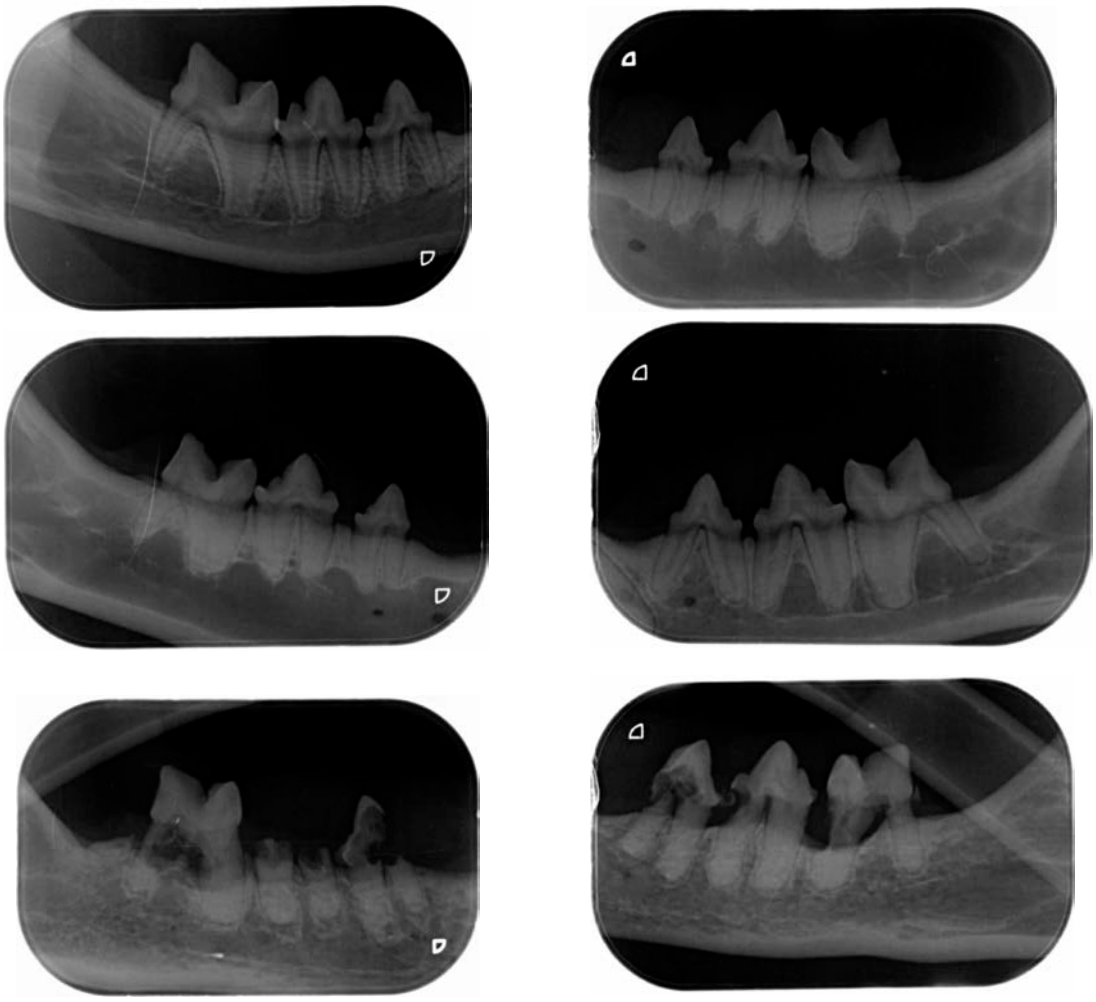


FIG 1. The parallel technique is used for the mandibular premolars and the molars. The patient is placed in lateral recumbency (with the side to be radiographed uppermost). The film is placed between the tongue and the teeth and pushed as far down into the sublingual fossa as possible. The x-ray beam is then directed from lateral to medial at right angles to the long axis of the tooth. The resulting image of the tooth has very little magnification or distortion. Due to the anatomy of the oral cavity, this technique is only possible in the mandibular premolar and molar regions s rapid screening technique for feline odontoclastic resorptive lesions

M. HEATON, J. WILKINSON, C. GORREL AND R. BUTTERWICK Journal of Small Animal Practice (2004)45, 598–601*



Results

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

Chi square + post hoc + Cramer	Dental inflammatoir group			
	Chi-square P	post hoc P	bonferroni correction	φ/Cramer´s V
			adjusted p-value 0,00056	
Household structure				
The social interaction				
Does the feline keep an eye on other animals (rodents, rabbits)?	0,043 c+	0,02781		0,253
Does the feline likes to play with conspecifics?	0,000 c+	0,00032	0,00032	0,408
Movement and instinct behavior				
Walking on the rooftop of the neighbours?	0,008 dig+	0,00511		0,54
Clinical Health				
Owner care taking				
Is there a place where the cat will not be disturbed?	0,015 c+	0,00932		0,277
Has the feline access to all the rooms of the household?	0,008 dig+	0,00511		0,297

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

Chi square + Cramer V	PURE TR				Pure FCGS				FCGS and TR			
	Chi-square P	post hoc P	Bonferroni	φ/Cramer´s V	Chi-square P	post hoc P	Bonferroni	φ/Cramer´s V	Chi-square P	post hoc P	Bonferroni	φ/Cramer´s V
			adjusted p-value 0,00056				adjusted p-value 0,00056				adjusted p-value 0,00056	
Household structure												
Asylum	0,009 tr+	0,02781		0,403	0,009 fc+	0,0455		0,403	0,009 ft+	0,05743		0,403
The social interaction												
Does the feline likes to play with conspecifics?	0,000 c+	0,00189		0,511	0,000 c+	0,06562		0,511	0,000 c+	0,19883		0,511
Does your cat fear other cats	0,008 tr+	0,00105		0,383	0,008 fc+	0,03443		0,383	0,008 ft+	0,19643		0,383
Movement and instinct behavior												
Walking on the rooftop of the neighbours?	0,003 tr+	0,78178		0,624	0,003 fc+	0,00133		0,624	*NA n=0			
Is your cat an indoorcat?	0,012 tr+	0,07465		0,353	0,012 c+	0,35174		0,353	0,014 c+	0.00422		0,353
Clinical Health												
Owner care taking												
Is there a place where the cat will not be disturbed?	0,044 c+	0,05486		0,293	0,044 c+	0,95937			0,044 c+	0.61868		
Has the feline access to all the rooms of the household?	0,009 tr+	0,54412		0,362	0,009 fc+	0,51977		0,362	0,009 ft+	0.01645		0,362

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

Chi square + Cramer	All FCGS				All TR			
	Chi-square P	post hoc P	Bonferroni	φ/Cramer´s V	Chi-square P	post hoc P	Bonferroni	φ/Cramer´s V
			adjusted p-value 0,00056				adjusted p-value 0,00056	
Household structure								
Asylum	0,033 fc+	0,22716		0,308	0,033 tr+	0,00904		0,308
The social interaction								
Does your cat greet other cats?	0,047 c+	0,59632		0,294	0,047 c+	0,02819		0,294
Does the feline likes to play with conspecifics?	0,000 c+	0,69913		0,467	0,000 c+	0,00066		0,467
Does your cat fear other cats	0,013 c+	0,01097		0,318	0,013 tr+	0,00463		0,318
Movement and instinct behavior								
Walking on the rooftop of the neighbours?	0,002 fc+	0,00071		0,646	0,002 tr+	0,72424		0,646
Clinical Health								
Owner care taking								
Is there a place where the cat will not be disturbed?								
Has the feline access to all the rooms of the household?	0,01 fc+	0,19281		0,313	0,01 tr+	0,14995		0,313

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

Mann whitney, exact sign 2tailed	Dental inflammatoir group	
	P-value	bonferroni correction
Household structure		adjusted p-value 0,00056
How many childeren does your household have	0,02809 c+	
The social interaction		
Is your cat aggresive towards conspecifics	0,00460 dig+	
Does your cat likes to play with humans	0,00022 c+	0,00022
Movement and instinct behavior		
Clinical Health		
Do you think your cat has stress, please give an estimation on a scale based 0-10	0,00468 dig+	
Do you think your cat has pain please give an estimation on a scale based 0-5	0,00005 dig+	0,00005
How frequent do you deworm your cat each year?	0,00000 c+	0,00000.
Owner care taking		
How often do you change foodbrand	0,00040 c+	0,00040.
How many waterbowls are there in the household?	0,02504 dig+	

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

Kruskall-Wallis	Pure TR			Pure FCGS			FCGS and TR		
	P-value	Post hoc p-value	bonferroni correction	P-value	Post hoc p-value	bonferroni correction	P-value	Post hoc p-value	bonferroni correction
Household structure			adjusted p-value 0,00056			adjusted p-value 0,00056			adjusted p-value 0,00056
The social interaction									
Is your cat aggressive towards conspecifics?	0,000 tr+	0,00016	0,00016	0,000 fc+	0,38499		0,000 ft+	0,01662	
Does your cat likes to play with humans?	0,003 c+	0,04282		0,003c+	0,00002	0,00002	0,003 c+	0,12697	
Do your cats trust each other?	0,021 c+	0,08964		0,021c+	0,15076		0,021 c+	0,00079	
Does your cat likes to play with toys?									
Does your cat likes to be petted by you?	0,000 c+	0,38694		0,000 fc+	0,57194		0,000 c+	0,00001	0,00001
Does your cat likes being to be petted by a stranger?	0,007 c+	0,51561		0,007 c+	0,66229		0,007 c+	0,00105	
Movement and instinct behavior									
Does your cat likes to lay in the windowsill	0,000 c+	0,04919		0,000 c+	0,71361		0,000 c+	0,00046	0,00046
Clinical Health									
Do you think your cat has stress, please give an estimation on a scale based 0-10	0,016 tr+	0,02298		0,016 fc+	0,02886		0,016 ft+	0,00588	
Do you think your cat has pain please give an estimation on a scale based 0-5	0,000 tr+	0,00391		0,000 fc+	0,00002	0,00002	0,000 ft+	0,00005	0,00005
How frequent do you deworm your cat each year?	0,000 c+	0,00000.	0,00000.	0,000 c+	0,00001	0,00001	0,000 c+	0,01023	
Owner care taking									
How often do you change foodbrand?	0,004 c+	0,00031	0,00031	0,004 c+	0,06511		0,004 c+	0,03118	

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

Kruskall-Wallis	All TR			All FCGS		
	P-value	Post hoc p-value	bonferroni correction	P-value	Post hoc p-value	bonferroni correction
Household structure			adjusted p-value 0,00056			adjusted p-value 0,00056
How many childeren does your household have?						
The social interaction						
Is your cat aggressive towards conspecifics?	0,000 tr+	0,00022	0,00022	0,000 fc+	0,09970	
Does your cat likes to play with humans?						
Do your cats trust each other?						
Does your cat likes to play with toys?						
Does your cat likes to be petted by you?	0,000 c+	0,27224		0,000 c+	0,00000.	0,00000.
Does your cat likes being to be petted by a stranger?	0,000 c+	0,40029		0,000 c+	0,00000.	0,00000.
Movement and instinct behavior						
Does your cat likes to lay in the windowsill	0,000 c+	0,07441		0,000 fc+	0,00000.	0,00000.
Clinical Health						
Do you think your cat has stress, please give an estimation on a scale based 0-10	0,009 tr+	0,00633		0,009 fc+	0,00530	
Do you think your cat has pain please give an estimation on a scale based 0-5	0,000 tr+	0,00079		0,000 fc+	0,00000.	0,00000.
How frequent do you deworm your cat each year?	0,000 c+	0,00000.	0,00000.	0,000 c+	0,00001	0,00001
Owner care taking						
How often do you change foodbrand?	0,001 c+	0,06364		0,001 c+	0,019	

All significance found are placed below within in an excel overview. The results are sorted by statistical test and type of distribution. The numbers within the cells are the found p value and the letters behind the p value shows which group has the significantly higher mean value. Example: C=control group. Blank cells mean that a higher number than 0.05 has been found and which would not come near the 0.05 value. P-values which were lower than the calculated Bonferroni correction (p-value of 0.00056), are enlisted in the column of the Bonferroni. *The numbers in red are not significant but close to the 0.05 value or did not make*.

T-Test sign 2-tailed	Dental inflammatoir group		Pure TR		Pure FCGS		FCGS and TR	All TR	All FCGS
	P-value	bonferroni correction	P-value	bonferroni correction	P-value	bonferroni correction			
Household structure		adjusted p-value 0,00056		adjusted p-value 0,00056		adjusted p-value 0,00056			
The social interaction									
For how long have your cats been living together?	0,014 dig+		0,017 tr+		0,026 fc+				
Movement and instinct behavior									
Clinical Health									
Owner care taking									

Stress as a main contributor to FCGS and TR, plausible?

Universiteit Utrecht

DIERENKLINIEK
WILHELMINAPARK

Utrecht, dd ……..
(gaarne de datum op de stippellijn invullen)

Hierbij verleen ik, ……..
(gaarne uw naam op de stippellijn invullen)

toestemming voor röntgenologisch onderzoek bij mijn kat

……
(gaarne de naam van uw kat op de stippellijn invullen)

De genomen röntgenfoto's zullen gebruikt worden voor wetenschappelijk onderzoek naar de invloed van stress op de ontstaanswijze van gingivitis (tandvleesontsteking) en tandresorptie (tandverlies) bij de kat. Tevens stem ik in om deel te nemen aan een enquête, waarin gevraagd wordt naar de leefomstandigheden van mijn kat. De uitnodiging voor de enquête mag gestuurd worden naar het volgende emailadres.

……
(gaarne uw emailadres op de stippellijn invullen)

Handtekening

……..

Universiteit Utrecht

DIERENKLINIEK WILHELMINAPARK

Geachte kattenbezitter,

Het komt regelmatig voor dat dierenartsen katten op het spreekuur zien met problemen aan het gebit. Dit varieert van een vieze geur uit de bek tot een zeer stinkende en pijnlijke bek. Dit kan zelfs zo pijnlijk zijn dat de kat weigert om te eten, zich afzondert of zich juist heel agressief gedraagt. Soms volstaat een gebitsreiniging, echter er is meestal meer met het gebit aan de hand.

Dit kan duiden op een ontstoken tandvlees (stomatitis/gingivitis) en op resorptie van tanden(tandresorptie). Beide varianten kunnen door ontsteking zeer pijnlijk worden. De behandeling van deze pijnlijke gebitsaandoeningen is veelal het trekken van de tanden, waaromheen ontsteking te zien is. Soms is de aandoening dusdanig uitgebreid dat **alle** tanden getrokken worden.

De ontstaanswijze van zowel het ontstoken tandvlees als de tandresorptie is tot heden onbekend. Dit betekent ook dat we niet precies weten hoe we deze aandoeningen moeten voorkomen. Als we dit wel weten, kunnen we veel dierenleed besparen door tijdig preventieve maatregelen te treffen.

Vanuit de faculteit Diergeneeskunde wordt er gekeken naar een eventuele rol van stress op de ontstaanswijze van beide gebitsaandoeningen. Aan de hand van een vragenlijst wordt er onderzocht of er sprake is geweest van stress bij deze katten. Om de antwoorden in goed perspectief te kunnen plaatsen, dient dezelfde vragenlijst ook afgenomen te worden bij eigenaren waarvan diens kat een gezond gebit heeft.

In een samenwerkingsverband met dierenkliniek Wilhelminapark wordt er voor dit onderzoek gezocht naar katteneigenaren, die bereidt zijn om mee te werken aan dit onderzoek en waarvan hun kat een gezond gebit heeft. Om er zeker van te zijn dat een kat geen tandresorptie of stomatitis/gingivitis heeft, is een gebitsinspectie en 2 röntgenfoto's van het gebit essentieel. Hiervoor dient een kat te slapen.

Uw kat staat ingeroosterd om binnenkort bij de dierenkliniek Wilhelminapark onder anesthesie te gaan en zal daarbij in een diepe slaap gebracht worden. U zou ons en vele katten helpen, als u aan dit onderzoek mee zou willen doen.

Indien u bereidt bent om mee te helpen aan het onderzoek, dient u het meegeleverde formulier te ondertekenen. Door dit te ondertekenen, verleend u toestemming om 2 röntgenfoto's van het gebit te maken. Het maken van de röntgenfoto's zal geen extra anesthesietijd opleveren en deelname aan het onderzoek is kosteloos. Na de screening zal er contact met u worden opgenomen door ondergetekende om de vragenlijst bij u af te nemen. Het formulier kunt u bij de balie van dierenkliniek Wilhelminapark inleveren, als u uw kat komt brengen voor de operatie. U zou ons en vele katten helpen als u meedoet!

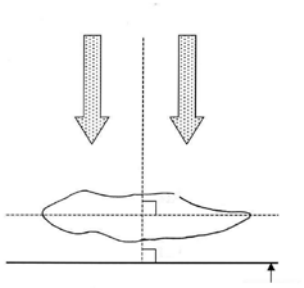
Met vriendelijke groet,

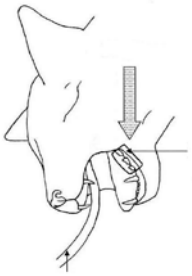
Wouter van Aerde, 6e-jaars diergeneeskundig co-assistent.

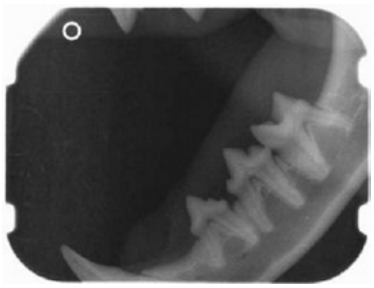
Instructie na een getekende formulier.

Na de kat succesvol geanestheseerd te hebben, is het wenselijk om als eerste een gebitscontrole/inspectie uit te voeren (alleen optisch). Let hierbij op enige afwijkingen aan de tanden, het tandvlees en de binnenkant van de wangen. Mocht dit duiden op een ontstoken beeld, dan is deze kat niet geschikt voor het onderzoek. Als de kat gezond is en daarmee geen gingivitis heeft, dan graag een “normale/telefoon” foto maken van het gezonde beeld.

Naar gelang het beste uitkomt, voor of na de operatie, dient er een dentale röntgenfoto gemaakt te worden van de premolaren in de kwartieren 3 en 4, oftewel links en rechtsonder. Het is met name belangrijk dat de wortels van de 307 en 407 goed zichtbaar zijn op de foto’s, aangezien tandresorptie zich hier als eerste manifesteert. De 307 en 407 zitten vlakbij de snijtand. Hoe je deze foto maakt is gedemonstreerd op de foto:







Hierbij gaat de plaat aan de linguale zijde van de premolaren. De plaat kan je op zijn plek houden, door tussen de plaat en de tong de ruimte op te vullen met gaasjes. Tevens kan het handig zijn om een beksperder te gebruiken. Aangezien de tube in de weg zit bij het maken van de foto als deze aan de onderkaak is vastgebonden, is het handig om de tube of aan de bovenkaak vast te maken of vlak voor het extuberen, de tube los te maken van de onderkaak en dan de foto te maken.

Na het maken van de rongenfoto, graag deze opslaan, onder de naam van de kat/eigenaar. De gebitsfoto, de röntgenfoto’s en de getekende formulieren kom ik later ophalen.

conclusie
- Ondertekend? → gebitsinspectie, gezond? → foto telefoon → rofo 307, 407 → foto’s en toestemmingsformulier bewaren.

Met vriendelijke dank

Wouter van Aerde