



ESTONIAN UNIVERSITY OF LIFE SCIENCES
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**HOMECARE IN PREVENTION OF PERIODONTAL
DISEASE IN DOGS AND CATS: OWNER AWARENESS
AND ATTITUDES**

KODUHOOLDUS KOERTE JA KASSIDE
PERIODONTAALHAIGUSE ENNETUSEKS: OMANIKE
TEADLIKKUS JA SUHTUMINE

Final Thesis

Curriculum in Veterinary Medicine

Supervisors: Veterinarian Kadri Kääramees

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<p><i>Periodontal disease is a major problem in dogs and cats and has also been studied extensively. Hand in hand with advancement of veterinary medicine, the knowledge of extent and consequences of periodontal disease and importance the of homecare is increasing. Homecare plays a critical role in prevention of periodontal disease and there are numerous oral homecare solutions available, but one must be aware of different efficacy of various products and methods. Also, anesthesia-free dental procedures have increasingly been on public display but are considered insufficient and even detrimental by the veterinary profession due to causing delay in correct assessment and treatment.</i></p> <p><i>The material was collected in the form of questionnaires from dog and cat owners visiting a veterinary clinic, in total 299 responses were received. Questions inquired about extent and methods of oral homecare applied, owner's assessment of their pet's oral health, awareness of signs of dental problems and required procedures. Results indicated that a majority of dog (73%) and cat (90%) owners did not brush their pet's teeth at all with the main reason given that they have not received an advice to do so. In cats use of dental complementary products (special diets. chews. feed additives etc.) was not popular but in dogs, majority of owners were using them at different frequencies.</i></p> <p><i>Some strong associations were also found between history of visits due dental problems, pet's higher age and owner's desire to gain more information about oral health with the higher risk of pet's worse oral health status as assessed by the owner.</i></p>			
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<p><i>Periodontaalhaigus on koerte ja kasside puhul oluline probleem ja seda on ka põhjalikult uuritud. Käsikäes veterinaarmeditsiini arenguga süveneb ka teadmus periodontaalhaiguse ulatusest ja tagajärgedest ning suuõõne koduhoolduse tähtsusest. Koduhooldus omab olulist rolli periodontaalhaiguse ennetuses ning suuõõne koduhoolduse lahendus on mitmeid, ent on vaja olla teadlik erinevate toodete ja meetodite erinevast efektiivsusest. Samuti on anesteesiata hambapuhastusprotseduurid kasvavalt esile kerkinud, kuid professionaalsest veterinaarsest vaatepunkt loenb neid ebapiisavateks ja isegi kahjulikeks, kuna nad viivad diagnoosimise ja ravi hilinemisele. Uurimismaterjal koguti küsimustike abil, mida täitsid loomakliinikud külastanud koera- ja kassiomanikud. Küsimused hõlmasid rakendatava suuõõne koduhoolduse ulatust ja meetodeid, omanikupoolset hinnangut oma lemmiku suuõõne tervisele, teadlikkust hambaprobleemide tunnustest ja vajalikest protseduuridest. Tulemused näitasid, et enamik koera- (73%) ja kassiomanikke (90%) ei harja oma lemmiku hambaid üldse ja peamise põhjusena mainivad omanikud sellekohase nõuande puudumist. Kasside puhul ei olnud hammaste ja suuõõne tervist toetavate toodete (erisöödad, närimismaiused, söödalisandid jne.) kasutamine populaarne, ent koerte puhul kasutas neid enamik omanikest erineva sagedusega. Samuti olid hambaprobleemidest tingitud varasemad kliinikukülastused, lemmiku kõrgem vanus ja omaniku soov saada rohkem informatsiooni lemmiku suuõõne tervise kohta tugevalt seotud riskiga, et omanik hindab oma lemmiku suuõõne tervisestaatust halvemaks.</i></p>			
Märksõnad: periodontaalhaigus, koduhooldus, koer, kass, suuhügieen			

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INTRODUCTION

Periodontal disease has a major role among diseases affecting dogs and cats and it is a cause of major discomfort to those affected by it (Niemiec, 2013). With advancement of veterinary medicine, the knowledge of mechanisms behind and consequences of periodontal disease as well as homecare and its impact on oral health has improved. Professional dental cleaning, more descriptively Comprehensive Oral Health Assessment and Treatment (COHAT) is one very important part of prevention and treatment of periodontal disease (Niemiec *et al.*, 2017). Another major aspect in fighting against periodontal disease and preventing it from proceeding is oral homecare provided by owners. The impact of dental diseases and the importance of homecare have been somewhat underestimated in the past especially among animal owners. Major reason for unrecognized periodontal disease by owners is that there are no or only few clinical signs to be easily noticed by owners and when signs are noticeable the disease is often already at an advanced stage (Niemiec, 2008). There are a lot of different possibilities for homecare; toothbrushing, antiseptic rinses, gels, chews, diets and water additives (Niemiec, 2013).

This descriptive study was made about homecare and its implementation among dog and cat owners in Estonia. Also, it was wanted to find out if there are any risk factor that may have an impact on owners' assessment of their pets' oral health status. In order to be able to improve quality of oral homecare among pet owners, it must be known at which level their awareness about oral problems and dental care are, which kind of homecare owners are providing at the moment and factors that may influence it.

1. LITERATURE REVIEW

1.1 Periodontal disease

Periodontal disease in dogs and cats is very common, one of the most diagnosed diseases, and can have potentially serious secondary conditions (Logan *et al.*, 2002; Flancman *et al.*, 2018). According to two different studies in England both by O'Neill *et al.* (2014) the most frequently diagnosed disorder in dogs was otitis externa and the second most recorded was periodontal disease (n = 361; 9.3%) and in cats the periodontal disease was the most prevalent (n = 499; 13.9%) as well as all dental conditions being the most prevalent disorder group (n = 540; 15.1%). Also, in study by Robinson *et al.* (2015) they found out dental calculus to be second most common clinical examination finding of all (n = 3042; 5.6%) and of non-presenting (n = 1944; 8.3%) problems.

As a term periodontal disease refers to gingivitis and periodontitis (Logan *et al.*, 2002; Nises *et al.*, 2018)). Gingivitis is an inflammation of gingiva and will always precede periodontitis (Ingham and Gorrel, 2001; Smith and Smithson, 2014). Gingivitis is reversible condition and largely prevented by effective plaque and calculus control (Logan *et al.*, 2002; Gorrel, 2013). Mechanical disruption of dental plaque formation will restore and maintain gingival health (Gorrel, 2013). The primary cause of gingivitis is biofilm or plaque accumulation (Clarke *et al.*, 2011; Gorrel, 2013; Quest, 2013) which starts by forming an acquired pellicle containing salivary proteins (Smith and Smithson, 2014) on teeth surface within nanoseconds after cleaning the teeth (Niemić, 2013). Oral aerobic gram-positive bacteria start to adhere to the pellicle and start the formation of dental plaque (Hale, 2003; Gorrel, 2013; Bellows *et al.*, 2019). This bacteria-containing plaque will colonize the surface of the tooth within 24 hours after cleaning (Niemić, 2015). If plaque is left undisturbed, it will be in constant contact with saliva and will mineralize forming dental calculus (Clarke *et al.*, 2011; Smith and Smithson, 2014). This mineralization from dental plaque into calculus starts already within two days (Hale, 2003; Watanabe, 2016). Calculus itself consist of organic matter, food particles, calcium phosphates and carbonates (Smith and Smithson, 2014). If the progression of gingivitis is not disrupted, some

individuals may develop periodontitis (Logan *et al.*, 2002). In case of periodontitis there is gingivitis with progressive inflammation and attachment loss meaning the destruction of elements of periodontium including cementum, periodontal ligament and alveolar bone (Logan *et al.*, 2002; Milella *et al.*, 2014; Smith and Smithson, 2014). Periodontitis is irreversible, but the progression of the disease is preventable, although, it usually requires meticulous homecare and advanced veterinary dental therapy (Logan *et al.*, 2002).

Periodontal disease will cause discomfort and in prolonged and severe cases may have also very serious local complications as well as systemic effects and cause diseases in kidneys, myocardium and liver in dogs and cats (Clarke, 2001; Logan *et al.*, 2002; Gorrel, 2013). Commonly seen local consequences include oronasal fistulas which form a communication between oral and nasal cavity (Lobprise, 2000). Most often they are seen with advanced periodontitis in maxillary canines on palatal side but all maxillary teeth are prone (Niemiec, 2008; Niemiec, 2013). On multirooted teeth are seen something called class II perio-endo abscesses which cause bacterial contamination by accessing endodontic system in advanced periodontal loss (Niemiec, 2008; 2013). This is often seen especially in small and toy-breed dogs (Niemiec, 2008). Also, pathological fractures mainly in mandible at site of canines and first molars are seen. This, too, is mostly seen in small and toy-breed dogs due to the fact that they have very small amount of mandibular bone around apical root (Niemiec, 2013). Inflammations near the eye on maxillary jaw can also cause retrobulbar abscesses and blindness. Chronic periodontal disease can also lead to oral cancer and osteomyelitis (Niemiec, 2008; 2013). Systemic manifestations include bacterial endotoxin, cytokines and inflammatory mediators induced organ dysfunction through vascular system (Bellows *et al.*, 2019) in various organs; possibly endocarditis, thromboembolism and cerebral and myocardial infarctions (Niemiec, 2008).

1.2 Homecare

Professionally cleaning the teeth of cats and dogs predisposed or suffering from periodontal disease is only one, although important, part of dental health care (Hale, 2003). Homecare done by owners has a critical aspect in fighting against periodontal disease (Niemiec, 2013). As a term homecare means anything owners do at home regularly to prevent gingivitis ja

periodontitis and accumulation of plaque and calculus (Hale, 2003). If proper homecare is not consistently performed after professional periodontal therapy, biofilm starts to accumulate immediately, within 24 hours, after cleaning (Clarke *et al.*, 2011; Niemiec, 2015) and the periodontal pockets will be colonized again within two weeks and the depth can return to same as before treatment within six weeks (Hale, 2003; Niemiec, 2013). While toothbrushing as dental homecare has been considered the golden standard in dental homecare, there are some scenarios in which other options must be considered for plaque control in animals that are not so compliant for toothbrushing, for example cats. This can also be a question of safety of the animal and the owner (Bellows *et al.*, 2012). Although the use of special dental diets, treats or other additional plaque and calculus control products does not exclude the necessity of regular professional dental therapy, it does improve greatly the gingival health in between professionally done dental therapies and decrease the amount of calculus developing during that time (Ingham *et al.*, 2002). Still, it must be remembered that homecare is only effective on those teeth surfaces that owner or any product is able to reach (Hale, 2003).

Homecare can be divided into active and passive homecare (Niemiec, 2013). Active homecare requires owner activity and comprises brushing with or without pastes and use of rinses and barrier sealants (Niemiec, 2013; 2015). Passive homecare can be easier to perform especially in animals not compliant with active homecare procedures and includes tartar control diets, raw diets, calculus control treats and water additives (Niemiec, 2013). Active and passive homecare both have their own benefits but most effective would be their combination (Milella *et al.*, 2014). Active homecare is more efficient in regard to front teeth while passive homecare, such as dental chews have more effect on carnassial (fourth premolar) and surrounding teeth which are used in chewing and shearing food. (Niemiec, 2013; 2015).

When performing any dental homecare, one can search for approved products from the Veterinary Oral Health Council (VOHC) (Holmstrom *et al.*, 2013; Niemiec, 2013; Bellows *et al.*, 2019). The Veterinary Oral Health Council lists products that meet its preset standard for the retardation of plaque and calculus accumulation (Holmstrom *et al.*, 2013; Bellows *et al.*, 2019). Their list has last been updated on February 2019. In order to get the Seal of Acceptance, products must be proven to have an efficacy against plaque or calculus accumulation. According to VOHC (http://www.vohc.org/protocol_details.html,

20.5.2019), each product must be experimented twice with two different trials and examined for 28 days. When comparing the test group and control group according to VOHC requirements plaque or calculus must decrease 15% in each trial while in two required trials the average reduction has to be 20% with statistically significant difference ($p < 0.05$) in each.

1.2.1 Active homecare

Active homecare is defined by active participation of the owner in plaque removal from tooth surface and disruption of calculus formation. This can mean for example toothbrushing, use of antiseptic rinses or application of barrier sealants (Niemic, 2013).

1.2.1.1 Brushing

Daily toothbrushing has been considered nowadays to be the golden standard when talking about prevention of gingivitis and periodontal diseases and is a critical part of homecare (Bellows *et al.*, 2012; Niemic, 2013; Harvey *et al.*, 2015). It has been stated that toothbrushing is the most effective way to mechanically remove the plaque and thus inhibit the oral bacterial proliferation (Watanabe *et al.*, 2016). In recent study by Allan *et al.* (2018) was compared toothbrushing, daily dental chew and dental diet and their effects on plaque accumulation. After the six-week study period was discovered that with toothbrushing the dental plaque scores were significantly lower compared to other two groups with daily dental chew or dental diet, thus concluding toothbrushing being the most effective way in homecare in reducing plaque accumulation.

Also, important factors that affect efficacy of toothbrushing are frequency and quality (Milella *et al.*, 2014). In a blinded study made by Harvey *et al.* (2015) they evaluated which frequency of brushing was adequate to have an effect to accumulation of plaque and calculus and thus development of gingivitis in dogs. They studied four different brushing frequencies and a control group which had no brushing at all. All dogs in every group had same starting point and they all were brushed in similar manner with only tap water and fed with

same feed during trial period. At the end of 28-day period they discovered that only those animals that had their teeth brushed every day or every other day had statistically significantly ($p < 0,01$) reduced mean plaque value and calculus scores compared to dogs in control group. In daily brushed dogs the mean plaque value was 37.4% lower than control group but in dog brushed in every week was only 9.9% and those brushed every other week was 1.8%. Mean calculus score was 80.2% lower on those brushed daily compared to control group and dogs whose teeth were brushed every other day had 62.1% when weekly brushed had only 22.8% lower score. Also, mean Gingivitis Index scores were statistically significantly lower in dogs whose teeth were brushed daily or every other day.

Unfortunately, toothbrushing among owners is not yet widespread (Watanabe, 2016). To make the brushing easier and more familiar for animal owners, veterinarians should teach the owners the proper way of toothbrushing and familiarize them with the subject. It should be always discussed already at first puppy vaccination appointment (Niemiec, 2013; Bellows *et al.*, 2019) especially with small and toy breed dogs and brachycephalic breeds that are over-represented when talking about periodontal disease (Clarke *et al.*, 2011; Smith and Smithson, 2014; Lourenço *et al.*, 2018). Without any kind of dental homecare, small and toy breed dogs may start to develop periodontal disease as early as nine months of age (Holmstrom *et al.*, 2013). When animal is familiarized with brushing already on early age it will likely be much more compliant for the procedure later (Niemiec, 2015). Also, brushing should be started slowly, and mouth closed while gently brushing buccal surfaces of easily accessible teeth. (Niemiec, 2013; 2015). Toothbrushing is not totally simple, however, and there can also be some dangers (Hale, 2003; Niemiec, 2013). There is always a risk of animal owner getting bitten or causing pain for the animal while brushing in case of any lesions in the mouth or fractured crowns with exposed pulp (Hale, 2003). Also, too vigorous brushing or inappropriate technique can cause damage of gingival tissue (Marx *et al.*, 2016).

1.2.1.2 Brushes and pastes

There are a lot of different veterinary brushes available depending on the animal's size, temperament and experience with toothbrushing. Standard toothbrushes include double- and triple-ended canine toothbrush, small soft single toothbrush and circular feline brush. In

addition, human toothbrushes can be used, especially brushes of children and infants. These are right size and soft-bristled for small and toy breed dogs (Niemiec, 2013). Some dogs familiar with brushing also tolerate electrical brushes which have been proved to be more efficient in plaque removal than manual brush in human studies (Ccahuana *et al.*, 2018) and thus can be expected to be more efficient also with animals. With these brushes the patients' temperament must be considered since the vibration and movement can feel coarse and scare more sensitive ones (Niemiec, 2013). There are also finger brushes and finger wraps available on the market but there is some evidence saying that brushing with finger brush is not effective in plaque removal since it does not effectively reach to subgingival areas which would be one of the most important areas to clean (Graveland *et al.*, 2004; Niemiec, 2013). Use of finger brush may also carry a higher risk of injury for the owner or operator (Niemiec, 2013). In addition, as the toothbrushing is very important, one must also be noted that toothbrushes must be changed regularly due to viral and bacterial accumulation on the bristles of the toothbrush and the same toothbrush should not be used between different pets (Niemiec, 2013).

In veterinary medicine there are also available different toothpastes that increase the acceptance of toothbrushing by the pet and contain certain ingredients, such as calcium chelator, that have been shown to decrease the accumulation of calculus even more (Niemiec, 2015). Palatability has been increased by adding certain flavorings such as fish or chicken depending on the target group of the product (Niemiec, 2013). Since calculus is mainly non-pathogenic and does not cause gingivitis or periodontitis itself, it is notable that the use of brush or other device for mechanically removing the plaque is more important in preventing gingivitis and periodontitis than use of pastes. To make toothbrushing more acceptable without pastes, owners can also use other products such as pet's favorite canned food or tuna juice for cats by dipping the brush into the products before brushing (Niemiec, 2013).

1.2.1.3 Brushing technique

Veterinary Oral Health Council has standardized brushing techniques (http://www.vohc.org/pet_teeth_brushing.html, 19.5.2019) for dogs and cats that will be

used in all VOCH approved trials of dental health products in dogs and cats. As stated before, quality of brushing is important and for that reason these techniques could also be used as an example when teaching the owners how to brush animal's teeth properly and by covering all the teeth in the mouth. However, the ideal brushing technique may be possible to execute only in the most compliant patients and any kind and level of homecare is valuable when trying to prevent periodontal diseases. For dogs it is recommended to use a flat, soft bristle brush which will not injury the gingiva. If the brush is used without pastes, the head of the brush must be dipped into water to moisten the bristles. When starting the brushing, the brush head should be angled at 45 degrees with bristle tips pointing towards the gingival sulcus (Niemiec, 2013). Strokes with the brush should be horizontal and one should not use too much force. The whole mouth is being divided into ten different sets and for each part there should be four long horizontal strokes meaning in total there should be 40 strokes. Sets on maxillary jaw are incisors, left side canines and premolars 1-3, left side premolar 4 and molars 1-2, right side canine and premolars 1-3, premolar 3 and molars 1-2. On mandibular sets are all incisors and canines, left side premolars 1-3, left side molars 1-3, right side premolars and right side molars 1-3.

Since the buccal surfaces on the distal teeth tend to have the highest levels of calculus, it is advisable to start the brushing from external surfaces as described in this protocol and keep the animals' mouth closed as it is usually more easily tolerated than opening the mouth (Niemiec, 2013; Niemiec *et al.*, 2017). After the pet is more familiar with brushing, effort to clean the internal surfaces can also be made (Niemiec *et al.*, 2017).

For cats the method of brushing is somewhat modified. The restraining of cats is more difficult and requires a lot of co-operation from the animal. Guidelines of VOHC (<http://www.vohc.org/Cat-brushing-technique2016.pdf>, 21.5.2019) suggests cat to be placed on owner's lap with the cat's hind-quarters facing the owner's abdomen and with one forearm acting as a side bar and hand on top of the head with middle finger and thumb retracting the commissures of lips while other hand is using the toothbrush. Maxillary and mandibular teeth are brushed with the same strokes at the same time, with brush angled at 45 degrees towards maxillary gingival margin. Three strokes on each side are made, covering maxillary canine and premolar teeth and mandibular canine, premolar and molar teeth. For cats, brushing of lingual or palatal surfaces can be difficult to execute, depending on willingness

of the cat, and the necessity of cleaning of inside surfaces is also questionable since dental plaque and calculus accumulates more rapidly on the external surfaces.

1.2.1.4 Antiseptic and Anti-Plaque rinses and gels

Antiseptic rinses and gels can be used additionally in active homecare. Gels can also be used in place of toothpaste to increase efficacy of toothbrushing by improving plaque and gingivitis control in patients suffering from periodontal diseases (Milella *et al.*, 2014; Niemiec, 2015). Often used active ingredient in antiseptic rinses is chlorhexidine (Niemiec, 2013; 2015). Mechanism in these chlorhexidine-containing products is that they penetrate the cells by disrupting the bacterial cell walls and thus creating the precipitation of the cytoplasm (Niemiec, 2013). There are some disadvantages in use of chlorhexidine with small animals. It is not very palatable and thus, especially with cats, it may cause difficulties in use (Niemiec, 2013). Also, some staining of teeth may be seen with use of chlorhexidine, but it will disappear if use is discontinued and can also be polished off (Niemiec, 2013; 2015). When applied chlorhexidine-containing gels or rinses to an awake animal, there is also a risk of ingestion of the products, which may lead to adverse effects, such as salivation (Hennet, 2002).

As another option there are also soluble zinc salts containing products which have been proven to have an effect in plaque reduction too by creating unfavorable conditions for bacterial growth and as an advantage those tend to be tasteless which improves acceptance (Clarke, 2001; Niemiec, 2013). Additionally, these products may contain ascorbic acid which has an effect on collagen synthesis, normal capillary function and detoxification and thus improve healing after dental scaling or other dental procedures (Clarke, 2011; Niemiec, 2013; 2015). Especially for cats, zinc and ascorbic acid containing products are more palatable and may be more easily accepted when applied. In study by Clarke (2001) was discovered that application of a zinc ascorbate gel once daily after professional dental cleaning improved feline oral health by significantly reducing plaque and gingivitis.

1.2.1.5 Barrier sealants

One other option of active homecare is the use of barrier sealants. There are two barrier sealants available at the moment (Niemic, 2015) but only the one registered for professional use has got the Seal of Acceptance from VOHC. Sealants are applied into the gingival sulcus during professionally performed COHAT procedure in an anesthetized animal to help to prevent plaque accumulation (Bellows, 2016).

One mechanism of action in wax-based product is to create a hydrophobic surface on teeth (Niemic, 2013) and thus prevent the attachment of plaque and formation of calculus (Gengler, 2005; Bellows, 2016). Application is continued at home on weekly basis (Niemic *et al.*, 2017).

Another sealant, registered for professional use only, uses the polymer technology creating hydrophilic environment (Niemic, 2017). This product is applied professionally only after the scaling and has been proven to be effective against plaque for 30 days after application (Sitzman, 2013).

1.2.2 Passive homecare

Passive homecare is an alternative to or to be used additionally together with active homecare. There are many products available in the market but many of those lack proof of efficacy. VOHC has listed the products that have got the seal of acceptance (Holmstrom *et al.*, 2013; Niemic, 2013) meaning that those products have been proven to be effective against plaque and calculus. Use of these products in passive homecare requires minimal effort from the owner and pets tend to accept the products well. One must still remember that use of these products may give some percentage of reduction mostly in supragingival plaque and calculus but may not be effective enough in gingivitis reduction for all individuals since if the periodontal pockets have formed, the effect

of supragingival plaque and calculus in those is minor (Niemic, 2008). Also, importance in any kind of homecare is that there must be a continuance. (Niemic, 2013) In this regard, passive homecare may be superior to active homecare since it is easier to perform and thus most likely will be done continuously (Niemic, 2015).

1.2.2.1 Plaque control diets

Nutrition has an important role in oral hygiene and dental health. When considering different diets concerning oral health, it is not primarily the nutritional content that is critical but the form of the diet. A diet must provide either mechanical friction for the teeth by specific shape, size or structure while chewing or an anti-calculus agent, such as calcium chelator on the tooth surface (Holmstrom *et al.*, 2013; Niemic, 2013). In a study by Logan *et al.* (2002) was found that feeding the dental diet during the 6-month period significantly reduced gingivitis (36%) and plaque (39%) in dogs, compared to control group fed with normal commercially available dry dog food. It must be also noted that with many of dental diets available, the main effect is on cusp tips without any contact with gingival margin (Niemic, 2013). Within the structure of a certain kibble studied by Logan *et al.* (2002), there is a specific fiber matrix technology which requires a full bite before breaking it thus is able to decrease gingivitis by enabling gingival margin to be cleaned (Niemic, 2013; 2015).

1.2.2.2 Raw diets

Many owners in veterinary practice believe that feeding raw diet, more precisely bones or meaty bones, to their dogs and cats will help to keep the mouths clean and will remove calculus by mechanical forces; a study showed that up to one-third of dog breeders from the USA and Canada offered regularly raw bones to their dogs as part of their diet (Connolly *et al.*, 2014). In a study made by Marx *et al.* (2016) they discovered that use of raw bones in a diet is in fact an effective method in removing dental calculus in dogs as a part of homecare. In the study they used a bovine femur and compared also effects of spongy and cortical parts of the bone. Even though both had a significant effect on reducing dental calculus, they also

discovered that the use of spongy bone was even more effective especially in the beginning of the study based on the fact that while chewing the spongy bone the dogs' teeth were able to penetrate better the bone's structure and thus increase the area of contact between the teeth and the bone. While providing raw bones into animal's diet one should remember what possible risks it carries too. Raw animal material is a pathogenic risk, for example for Salmonella and the hard texture of bones carries a significant risk for tooth fractures, esophageal and intestinal obstructions as well as more mild digestive problems (Marx *et al.*, 2016). However, there are no studies available at present that would prove the efficacy of raw diets *per se* for periodontal disease. (Niemiec, 2013).

1.2.2.3 Plaque control treats

There are a lot of different chews and treats available on the market that claim to reduce halitosis, plaque and calculus in dogs and cats but many of them lack proof of efficacy (Niemiec, 2015). VOHC lists 24 different products with proven efficacy for dogs with different concurrent conditions or needs, for example with joint care, weight management and grain-free products. For cats there are also available three VOHC- listed treats that are meant for calculus control (http://www.vohc.org/all_accepted_products.html, 21.5.2019). Quest (2013) studied one of the VOHC accepted chew and its oral care benefits. During the 28 -day study period they discovered that study group receiving daily dental chew had significant reduction in gingivitis, plaque and halitosis. Also, calculus score for study group was 60% less than control group on the day 28. In another study by Clarke *et al.* (2011) was studied the effectiveness of a vegetable dental chew in toy breed dogs. In this a reduction in mean gingival score and mean plaque and calculus score was also discovered but no significant reduction in halitosis was recorded. On the other hand, there is no clinical evidence of long-term effects in case of discontinued use of dental chew (Clarke *et al.*, 2011). That is why continuance and consistency of product use are important (Niemiec, 2013). Among plaque control treats, also rawhide treats have been shown to be effective (Stookey, 2009). Additionally, combined with chews having an abrasive effect on teeth surfaces, there might be some added active ingredients, such as calcium chelators or antiseptic chlorhexidine to increase plaque reduction. This addition of antimicrobials, however, lacks proof of increasing the efficacy of the product (Brown, 2005; Niemiec,

2013). Consuming dental chews is also not without risks. In order to have an effective abrasion, treats must be hard, and it may lead to tooth fractures. Also, if an animal is greedy or incautious, choking or obstructions are possible (Niemiec, 2013). It should also be noted that reduced plaque and calculus with improved gingival status within test groups in different studies does not necessarily mean absolutely improved dental health (Quest, 2013).

1.2.2.4 Water additives

In 2019 updated list of VOHC accepted products there are a few different water additives available that have got the Seal of Acceptance from VOHC. Two of them are about to become available in 2019 (http://www.vohc.org/VOHCAcceptedProductsTable_Dogs.pdf, 22.5.2019). One of the active ingredients in these products is zinc gluconate, same as used in some of antiseptic rinses or gels. Other ingredients include antioxidants that reduce inflammation by strengthening the immune system (Dodds, 2018). In cat products there is added omega-3 fatty acids from salmon oil to reduce inflammations as well, although in a study by Lourenço *et al.* (2018) was discovered that adding omega-3 containing fish oil to the diet did not have a significant effect on plaque or gingivitis indexes. Another product containing xylitol was studied by Clarke (2006) and found to have an effect in reducing plaque and calculus, but this product to this day remains to stand without VOHC seal of acceptance. With use of xylitol there are some known adverse effects with certain doses in some animals, such as hypoglycemia and liver failure in dogs, so this product should be used with caution especially in small dogs (Murphy, 2018).

1.3 Anesthesia-free dental procedures

Sometimes especially with older animals the owners are afraid of anesthesia and they would prefer their animal's teeth to be cleaned by non-veterinarians without anesthesia. American Veterinary Dental College (AVDC), European Veterinary Dentistry College (EVDC) as well as the World Small Animal Veterinary Association (WSAVA) do not recommend the anesthesia-free dental cleaning practices due to various reasons.

COHAT is a procedure used in veterinary medicine which not only comprises cleaning and polishing of the teeth, but also a thorough evaluation of the periodontal tissues and the entire oral cavity. Any periodontal therapy for veterinary patients should be performed under general anesthesia with intubation, which allows safe and effective overall assessment and treatment (Holmstrom *et al.*, 2013; Niemiec *et al.*, 2017). Also, with animals the anesthesia is required to keep them immobilized which enables the veterinarian to perform thorough examination and ensure the safety of both the patient and the practitioner. Animals having procedures without anesthesia must be restrained and this kind of procedure in the oral cavity may cause a traumatic experience for the pet as the animal may need to be held in place by force during a possibly painful and definitely uncomfortable procedure. Under general anesthesia veterinarian is able to clean the mouth properly and without any pain or discomfort, as multimodal analgesia is a compulsory part of the gold standard of veterinary dentistry (Niemiec *et al.*, 2017).

During the anesthesia-free dental cleanings, it is only possible to clean the most visible parts of the teeth to make them appear cleaner, but periodontal disease-wise more important plaque at the gingival margin and within subgingival areas cannot be properly removed (Bellows *et al.*, 2019). This may result to the animal being affected by gingivitis and periodontitis without immediately visible plaque or calculus being present (Niemiec, 2015). This gives the false sense of security about the state of the mouth to the owners and a belief that their animals' teeth are properly examined and may thus delay the pet receiving necessary dental diagnostics and treatment that can only be provided by a professional veterinarian. Also, during the anesthesia-free dental cleaning there is no way of performing dental radiography which is an important aspect in diagnosing periodontal disease and getting the overall impression of the clinical state of the mouth.

Anesthesia-free dentistry at its best may be ineffective or when performed daily it may be compared to brushing of teeth but can be very physically and mentally damaging at its worst (Niemiec *et al.*, 2017). This kind of dental cleaning, or any homecare, should never exclude the need of regular professionally performed COHAT procedure that include total oral health assessment, dental scaling, polishing and dental radiographs (Roudebush *et al.*, 2005; Bellows *et al.*, 2019).

2 AIMS OF THE STUDY

Aim of this study was to find out the state of oral homecare in dogs and cats in Estonia and the different ways of homecare the owners are performing in prevention of periodontal disease. One part of special interest was toothbrushing. To discover how many people are brushing the teeth of their pets, and if they are not brushing, the reasons for that. One of the objectives was also to find out what are the owner attitudes toward oral homecare and its necessity for their pets. Also, owner awareness of specific dental or oral problems and procedures were studied. The subject of interest was also to discover if certain risk factors are associated with pet's worse oral health status as evaluated by the owner, which the owners were shown to be able to do reliably in a previous study by Aula, 2018 (unpublished).

Aims of the study:

- Are owners implementing any homecare for oral health in their pets, which kind and how often?
- What do owners know about oral homecare and oral health?
- Are factors like species, implementing toothbrushing, history of visits with dental problems, pet's higher age or owner's desire to gain more information about oral health associated with the higher risk of worse oral health status as assessed by the owner?

Hypothesis:

- Owners are aware that toothbrushing is considered the best option in prevention of periodontal disease.
- Owners do use different means of homecare to prevent periodontal disease.

3 MATERIALS AND METHODS

3.1. Data collection via questionnaire

For the material collection in this study a paper questionnaire (Appendix 1 and 2) was used, which was distributed to five different small animal clinics in different places in Estonia. The questionnaire was offered to the owners for answering during the period from 3.12.2018 to 31.1.2019. Questionnaires were filled by owners visiting the Estonian University of Life Sciences Small Animal Clinic in Tartu (4.12.2018-31.1.2019), another small animal clinic in Tartu (17.1.2019-30.1.2019), one small animal clinic in Viljandi (5.12.2018-31.1.2019), and two different small animal clinics in Tallinn during the periods of 8.1.2019-1.2.2019 and 3.12.2018-9.2.2019 as well. Questionnaires were filled by the owners and they were available in Estonian, English and Russian languages. The reason for the clinic visit or presenting complaint played no part in selecting the sample, the incoming owners were simply given the questionnaire to fill while waiting for their visit if they agreed to it. A short, written introduction about what questionnaire is about and where it will be used was provided. Owners were also informed that the results would only be presents anonymously and their personal data would be protected.

In questionnaires the questions were made to survey the basic information about pets, history of dental problems, dental procedures and extractions as well as use of non-anesthetic dentistry, use of different homecare products and product type preferences. Also, questions about toothbrushing and owner assessment of pet's oral health were added as well as inquiry about changes seen in the mouth by owners, where do the owners find the information about pet oral health and whether they desire to gain more information and if so, where from.

3.2 Data handling

Data from all 299 questionnaires was entered into Microsoft Office Excel. Each questionnaire had its own identifying number and pets were identified with ID numbers assigned to them in the clinics at the time of filling the questionnaires, consisting of a code referring to the clinic, the date and the pet's ID number in the clinic software. All the answers were assigned a numerical value. Total number of patients used in further analysis is smaller than total number of all who filled the questionnaire because incorrectly or incompletely filled questionnaires were discarded from the analysis. Cleaning the data was done after all questionnaires were entered into the Excel spread sheet.

3.3 Statistical analysis

Logistic regression analysis was used to evaluate associations between owner assessment of pet's oral health status and certain possible variables that may have an influence in owner evaluation. Dependent variable was owner assessment of pet's oral health status (good = 0, moderate/bad = 1). Different independent variables were species (dog or cat), age in years, history of visiting to clinic for oral problems before, brushing, and wish for more information about oral health. Odds ratio (OR) was calculated with 95% confidence interval (95% CI). In statistical analysis 244 completed questionnaires were used as the data since in 55 questionnaires were some important information missing and thus, they were discarded from statistical analysis. Statistical significance level was set to $p < 0.050$ and $p = 0.051-0.099$ was interpreted as tendency.

Statistical analysis was done with statistical software Stata/IC 14.2 (StataCorp LP, College Station, TX, US).

4 RESULTS

4.1 Basic information of pets

During this data collection, in total 299 questionnaires were filled by the owners. Different number of questionnaires were used in different parts of the study because some parts were discarded due incomplete answering.

Average weight of dogs (n = 200) in this research was 18.37 kg. Variation of body weights in dogs was as follows: 17% under 5 kg, 25% 5.0-10.0 kg, 26% 10.0-25.0 kg and 29.5% had body weight of over 25.0 kg. Weight was not reported in 2.5% of dogs. In cats (n = 98) 42% weighed less than 5 kg and 24% were over 5 kg of body weight. Body weight of 34% of cats remained unrecorded.

Mean age of dogs in the study was 5.95 years. Only 32% of dogs were under 3 years old while 65% of dogs were over 3 years old and in 3% age was not recorded. 61% of cats were over 3 years old and 38% were 3 years or younger while the age of 1% of cats was not reported.

4.2 Brushing

60% of dog owners answered that they are not brushing their pet's teeth at all and an additional 13% informed that they have brushed their pet's teeth at some time previously but are not brushing anymore. This means that at the time of our study 73% of dog owners in total told they are not brushing their dog's teeth at all. With cat owners (n = 98) the percentages of non-brushers were even higher. 88% informed they have never been brushing their cat's teeth and additional 2% said they have brushed before but are not doing it anymore, meaning the total percentage of cats not having their teeth brushed with any frequency was 90% (Table 1).

Table 1. Owners who are not brushing their pet's teeth

	Dogs (n = 195)		Cats (n = 98)	
	n	%	n	%
Not brushing	117	60	86	88
Used to brush, not anymore	25	13	2	2
Total (not brushing+not anymore)	142	73	88	90

If the owners had answered either “not brushing” or “used to brush, not anymore” in previous questions, they were asked for the reason to that. There were some similarities within answers between dog and cat owners. In both groups, majority of participants answered they had not got the advice about the necessity of toothbrushing. In cats, the second most frequently picked answer option was that pet does not allow for owner to brush their teeth. In dogs, the second most common reason for not brushing was “other reason” (for which elaboration was invited in the questionnaire) and the third most common was that pet was not allowing it (Table 2).

From those dog owners who had chosen “other reason” for not brushing their dog's teeth (n = 29), 38% elaborated that they think giving chews or bones will be enough.

Table 2. Reasons for not brushing or not brushing anymore in dogs and cats

	Dogs (n = 124)		Cats (n = 66)	
	n	%	n	%
Pet does not allow	28	23	14	21
Human unable	9	7	6	9
Owner thinks not necessary	18	15	7	11
Has not received an advice	40	32	30	45
Other reason	29	23	9	14

4. 3 Use of complementary products

In the questionnaire it was asked if and how often owners were providing complementary products for oral homecare. It was discovered that 34% of dogs do receive complementary products but they are given those less than a couple of times a week. Only 17% of dog owners provided these additional products for their dogs daily. In cats, as much as 58% of owners informed that they are not giving any kind of complementary products for oral health care and only 14% answered that they give those daily (Table 3).

Table 3. Use of complementary products in dogs and cats

	Dogs (n = 192)		Cats (n = 95)	
	n	%	n	%
Complementary products given at least daily	32	17	13	14
Complementary products given a couple times a week	59	31	11	12
Complementary products given but less often	65	34	16	17
Complementary products not given	36	19	55	58

A big proportion of cat owners (70%), who answered why they are not giving any complementary products for their cats, informed that the reason is that they have not received any advice recommending doing so. Only 2% picked the reason that the products are too expensive. Up to 15% informed they think that complementary products are not suitable for their pet (Figure 1).

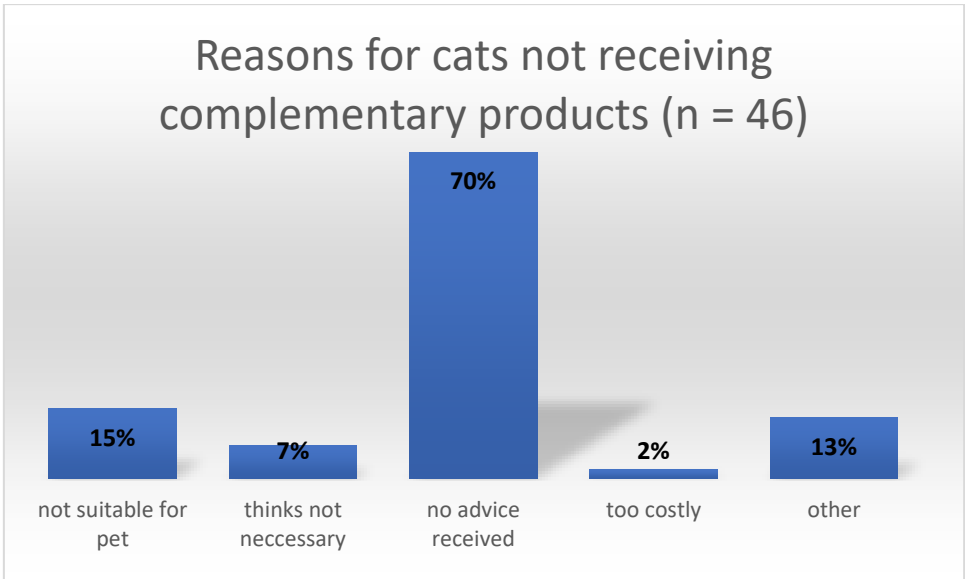


Figure 1. Reasons for cats not receiving complementary products (n = 46).

Most commonly used product types in dogs were chews and treats (91%). Very small portion (3%) of dog owners reported using water additives as complementary products in dental homecare but use of feed additives was the second most common (13%). (Figure 2).

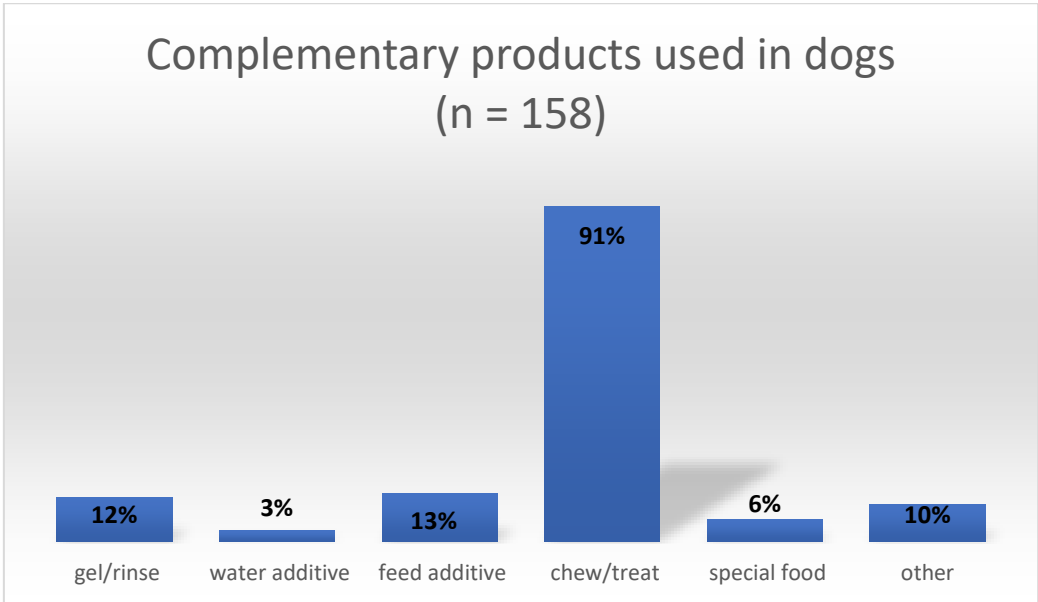


Figure 2. Complementary products used in dogs (n = 158).

4.4 Statements concerning pet's oral health

The last part of the questionnaire included general statements about pet oral health, disease prevention, the need of veterinary attention in certain conditions and efficacy and safety of awake dentals. Owners were asked if they agree with the statement or not. There was not much variation between the answers given by dog and cat owners, as seen in Figure 3.

92.8% of cat owners and 96% of dog owners agreed with the statement that a broken tooth requires veterinary attention. 62.7% of cat owners and a bit higher percentage of dog owners (72.6%) agreed that daily brushing is the best method in the prevention of gingival disease. Quite high percentage of dog (32.3 %) and cat (27.7 %) owners consider a non-anesthetic dental procedure to be beneficial and safe for dogs and cats (Table 4).

Table 4. Owner awareness about pet oral health; numbers and percentages of owners agreeing the statements

	Dog (n = 175)		Cat (n = 83)	
	n	%	n	%
No calculus means everything is okay with mouth and teeth	23	13	14	17
Bad smell is normal in a pet's mouth	10	6	7	8
Daily brushing is the best prevention against gingival diseases	128	73	52	63
A broken tooth requires veterinary attention	168	96	77	93
Awake dentals are beneficial and safe for a pet	56	32	23	28

Notes:

1. Symbol "n" tells the number of owners who agreed to the specific statement in the table.
2. Symbol "%" tells the percentage of owners agreeing to the statement and is calculated by positive answers from all received answers.

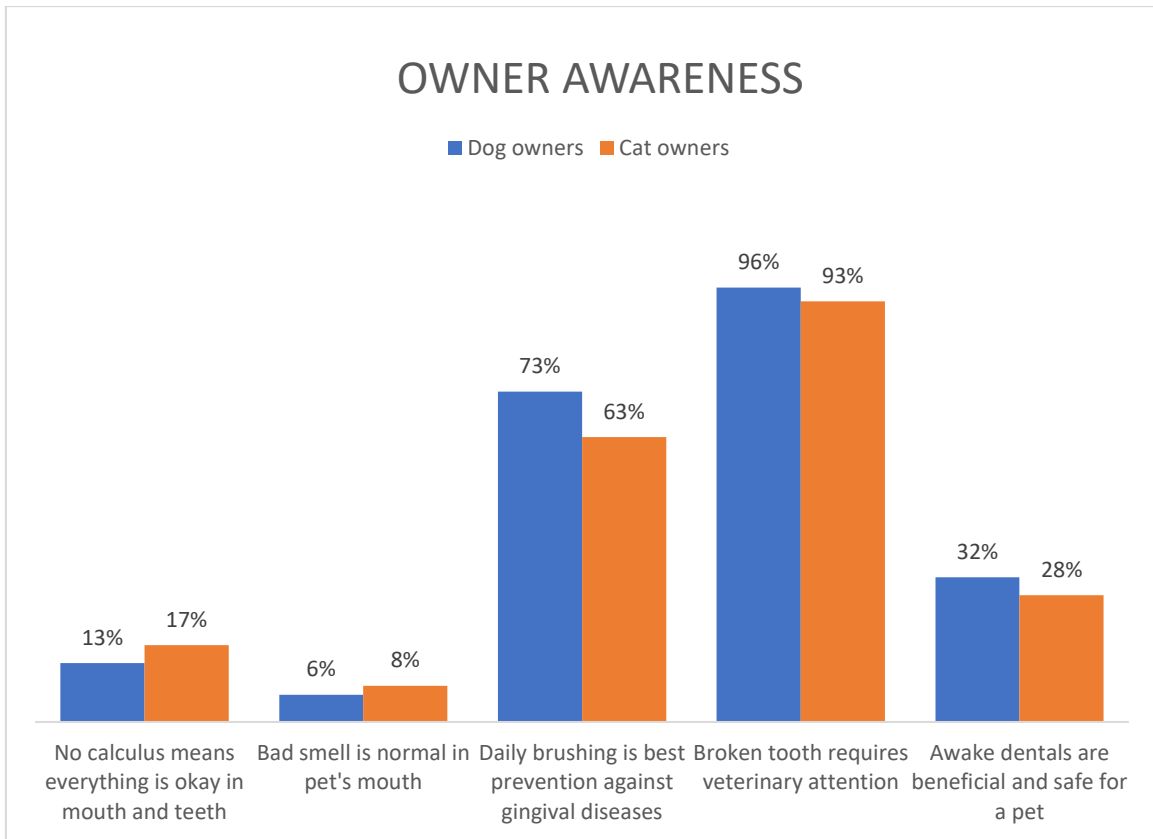


Figure 3. Percentages of owners agreeing to the statements concerning pet’s oral health. Dog owners: n = 175, Cat owners: n = 83.

4.5 Owner assessment of their pet’s oral health status

In the beginning of the questionnaire used in this study, owners were asked to evaluate their pet’s health status of oral cavity and teeth. They were given a possibility to choose “good”, “moderate” and “bad”. While making a logistic regression model from the answers, answers “moderate” and “bad”. In the study by Aula (2018) they used the same owner assessment scale with two combined possibilities and it was found that owner assessment correlated strongly with increased number of pathological findings by a veterinarian on an awake clinical exam, hence showing that owners are able to reliably evaluate their pets’ oral health status.

Table 5. Results of logistic regression model of owner assessment of pet’s oral health status and associations between possible risk factors. Data included 244 pet owners (152 dogs and 92 cats).

Variable	n	OR	95% CI	p-value
Species:				
Dog	152	1		
Cat	92	1.56	0.82; 2.98	0.179
Age (year)	244	1.35	1.24; 1.48	<0.001
Visit before for oral problems:				
No	182	1		
Yes	62	2.37	1.09; 5.16	0.025
Teeth brushing:				
No	186	1		
Yes	58	2.01	0.95; 4.25	0.086
Wish more information:				
No	76	1		
Yes	168	2.00	1.03; 3.89	0.043

It was found that there are associations between pet’s owner evaluated oral health status and teeth brushing, owner’s interest of getting more information about oral health, the pet having previous dental disease related history and the age of the animal. Cat owners assessed more easily their pet’s oral health state to be poorer, but it was not statistically significant ($p = 0.179$). Age was discovered to have a strong association with pet’s owner assessed oral health status as the owners of older animals evaluated the health status more easily to be poorer (OR 1.35; $p < 0,001$) compared to those who had younger animals. Also, those who had had previous clinic visits due dental problems had over two times higher risk to assess oral health state to be worse (OR 2.37; $p = 0.025$) compared to those who had reported no previous visits of the kind. Also, those owners who would have liked to get more information about oral health (OR 2.00; $p = 0.043$) were more likely to evaluate the oral health state to be worse. There was also tendency that owners brushing their pet’s teeth evaluated their pet’s oral health to be poorer (OR 2.01; $p = 0.086$), but it is not statistically significant.

5 DISCUSSION

As periodontal disease influences the majority of dogs and cats (Ingham *et al.*, 2002; Allan *et al.*, 2019), homecare must be addressed accordingly in addition to professionally performed oral and treatment (COHAT). The most effective way for maintaining oral health, decreasing gingivitis and preventing periodontal disease is by preventing plaque and calculus accumulation. This can be done by utilizing a combination of active and passive homecare together with regular professional oral health assessment and treatment procedures performed by a veterinarian.

In this study, it was found out that majority of dog and cat owners are not brushing their pet's teeth contrary to recommendations found in literature (Bellows *et al.*, 2012; Niemiec, 2013; Harvey *et al.*, 2015) where it is considered to be the golden standard in homecare. This finding supports the statement that toothbrushing among owners is not yet widespread (Watanabe, 2016). As many of the owners in this study informed, they feel that they have not got any advice recommending brushing their pet's teeth but still over a half of the owners responded that they know daily brushing to be the most effective way of preventing gingival disease. The fact that people are aware of theoretical benefits of toothbrushing in pets but do still neglect to implement it, should be addressed with the view of improving the situation by the veterinary profession as a whole. Education, motivation and communication (Bellows *et al.*, 2019) as regards to the prevention of oral disease are something veterinarians should endeavor to provide more to the owners during veterinary visits, for example during those first puppy vaccinations, as mentioned before (Niemiec, 2013), with also explaining in a way that owner can understand why it is actually important and how to perform oral homecare (Bellows *et al.*, 2019). Finding additional ways, for example in cooperation with different organizations, interest groups and pet shops, to spread information about homecare and its importance to pet owners could be beneficial.

Use of complementary products was quite popular with dogs, opposed in cats, and especially giving chews and treats to dogs played a major role. Only 19% of dog owners responded as not using any complementary products. In recent studies the use of dental chews has been proven to be effective in reduction of gingivitis, plaque and calculus (Quest, 2013) but in the

study by Allan *et al.* (2019) it was confirmed that toothbrushing is more effective in comparison to chews or diets. This means, that the use of dental chews could be a good way of homecare as an addition to toothbrushing, but not necessarily enough on its own since while using dental chews the differences in their effectiveness between individuals has been seen (Allan *et al.*, 2019).

Owner awareness was at quite a satisfactory level at least regarding the theoretical knowledge. Gingivitis which always precedes periodontitis (Smith and Smithson, 2014) and is a reversible condition (Gorrel, 2013; Bellows *et al.*, 2019) would be important to detect early before its progression. Owners were well aware of bad oral smell (halitosis) not being a normal finding and they were aware that an absence of dental calculus does not necessarily mean all is right in the mouth. Of course, this still does not mean that owners are reacting according to this knowledge in practice, as was seen from the very low percentage of people brushing their pet's teeth at any frequency. Unfortunate finding was that from the dog owners over a third and from the cat owners almost a third of respondents considered non-anesthetized dental procedures to be beneficial and safe for the animal. Since efficient plaque and calculus removal requires also subgingival areas to be cleaned, it is clear that awake dental cleanings, which can by their design only provide cosmetic cleaning of supragingival areas, cannot provide sufficient level of oral care (Bellows *et al.*, 2019). Also, as cleaning the whole dentition properly, also including subgingival areas, can be uncomfortable and somewhat painful for the animal, the need of general anesthesia is justifiable (Niemiec *et al.*, 2017). Owners should always be informed that no other than veterinary professional should ever perform any kind of scaling on their pet's teeth (Bellows *et al.*, 2019).

Signs of periodontal disease often go unnoticed by owners (Niemiec, 2008) and thus, it is important for professionals to know to what extent the owners can evaluate it more or less correctly and which factors may have an influence on it. Owner ability to evaluate pet's oral health at home is an important factor in their understanding of when and why oral homecare is needed. It was revealed there to be a strong association between owner assessment of pet's oral health as poorer and pet's increasing age. This finding makes sense as it is also shown that the existence of periodontitis is strongly correlated with increasing age (Wallis *et al.*, 2018). Also, an association was found between a tendency to evaluate oral health to be worse and the pet having a history of previous clinic visits concerning oral health. This relationship may arise from better understanding of pet's oral health since the owner has had some history

in dealing with such problems. This increases their awareness towards recognizing the first signs of emerging oral health problems. Also, the same reason may be behind the association between owner's desire to gain more information and their tendency to assess their pet's oral health status worse more easily; they may have a better understanding towards oral health problems.

Limitations of this study are related to the number of questionnaires filled and quality of answers. Number of cat owners participating in the study differed quite a bit from dog owners and thus, no proper comparison can be made between them. Also, since questionnaires were filled by owners without control, there were some incorrectly and incompletely filled questionnaires which had to be discarded from the study. In addition, the number of completed questionnaires was somewhat low. For more accurate analysis, more data would be required.

It would be interesting to do more research on this subject and also to study the differences between owners of different species of pets or look at the potential influence of owner related variables (for example the age, gender, location of the owners). In further studies it would be interesting to find out if there are differences in implementation of homecare between for example pure bred animals, mixed breeds, animals owned for working or racing or other competition purposes and animals kept only as pets, and how the owner profile might affect the awareness about pets' oral health and behavior regarding their pet's oral disease prevention.

6 CONCLUSIONS

In this study the aim was to gain information about the state of implementation of oral homecare in dogs and cats in Estonia, owner awareness about pets' oral health and risk factors affecting owners' evaluation of their pet's oral health status.

As a conclusion, people are quite aware of toothbrushing as an oral homecare method and it being the best way in preventing periodontal disease in their pets, but its implementation in reality is far from widespread according to this study, not even with older animals whose oral health status owners more likely assess to be bad. People seem to be aware of possible signs of disease in their pet's mouth and do know when to turn to a veterinarian but despite their knowledge of good practice of homecare, they have very often not actually implemented the active part of homecare in reality.

Education of the owners about pets' dental problems and how to most efficiently prevent periodontal disease and why daily brushing is the best way must continue. Owners' knowledge about homecare is at a good level but it must be carried out into daily practice as well.

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APPENDICES

Appendix 1. Questionnaire for the owners in English

Patient ID/...../..... <i>clinic ID / date. ddmmyy / patient ID in clinic</i>		Primary visit
Primary complaint/reason for visit			Recall visit
Ageyearsmonths OR date of birth...../...../.....(dd/mm/yyyy)	DOG	
		CAT	<i>mark answer with X</i>
WEIGHT ON VISIT	kg		<5 kg
Breed (according to owner statement)	Ideal adult weight		5-10 kg
			10-25 kg
			>25 kg

Questions for the owner : Please answer the following questions about the pet you have brought to the clinic. Please mark the correct answer/answers with X in the 3rd (empty) column .

By answering this survey you agree to participate in the study and give permission to analyse the generated data in anonymized form and publicize the results in generalised form (e.g. in a scientific publication). We assure that the anonymity and protection of the personal data of the owner and the pet is ensured in the data handling and analysis process and that the results of the survey will be presented in a generalised form only. We thank you for your participation in the survey!							
1.	In your assessment, what is the health status your pet's oral cavity and teeth /your pet's oral health like? (please choose one answer)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">good</td></tr> <tr><td style="text-align: center;">moderate</td></tr> <tr><td style="text-align: center;">bad</td></tr> </table>	good	moderate	bad		
good							
moderate							
bad							
2.	Have you noticed any of the following regarding your pet's mouth (please check all answers that apply):	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">unpleasant smell in mouth (halitosis)</td></tr> <tr><td style="text-align: center;">dental calculus (tartar) and/or plaque on teeth</td></tr> <tr><td style="text-align: center;">redness of gingiva (gums)</td></tr> <tr><td style="text-align: center;">something else that in your opinion is not normal (please elaborate)</td></tr> <tr><td style="text-align: center;">I have not looked into my pet's mouth</td></tr> </table>	unpleasant smell in mouth (halitosis)	dental calculus (tartar) and/or plaque on teeth	redness of gingiva (gums)	something else that in your opinion is not normal (please elaborate)	I have not looked into my pet's mouth
unpleasant smell in mouth (halitosis)							
dental calculus (tartar) and/or plaque on teeth							
redness of gingiva (gums)							
something else that in your opinion is not normal (please elaborate)							
I have not looked into my pet's mouth							
3.	Has your pet according to your knowledge <u>within the last year</u> been presented to a veterinarian because of a problem or a suspected problem of the mouth or teeth?	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">yes</td></tr> <tr><td style="text-align: center;">no</td></tr> </table>	yes	no			
yes							
no							
4.	Has your pet according to your knowledge <u>before than within the last year</u> been presented to a veterinarian because of a problem or a suspected problem of the mouth or teeth?	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="text-align: center;">yes</td></tr> <tr><td style="text-align: center;">no</td></tr> </table>	yes	no			
yes							
no							

5.	Has your pet according to your knowledge <u>within the last year</u> had a veterinarian - performed professional dental procedure ('dental cleaning', 'calculus removal') under general anaesthesia ('put under', 'put asleep' for the procedure)?	yes
		no
6.	Has your pet according to your knowledge <u>before than within the last year</u> had a veterinarian - performed professional dental procedure ('dental cleaning', 'calculus removal') under general anaesthesia ('put under', 'put asleep' for the procedure)?	yes
		no
7.	Has your pet according to your knowledge ever had any teeth extracted by a veterinarian under general anaesthesia ('put under', 'put asleep' for the procedure)?	yes
		no
8.	Has your pet according to your knowledge <u>within the last year</u> had a so-called dental cleaning/ calculus removal performed without general anaesthesia (to and awake animal, without the pet being 'put under/put asleep')?	yes
		no
9.	Has your pet according to your knowledge <u>before than within the last year</u> had a so-called dental cleaning/ calculus removal performed without general anaesthesia (to an awake animal, without the pet being 'put under/ put asleep')?	yes
		no
10.	Has your pet according to your knowledge ever had any teeth extracted without general anaesthesia (in an awake animal, without the pet being 'put under/put asleep')?	yes
		no
11.	Do you (or anyone else in your household) brush your pet's teeth? (please choose one answer)	yes, at least once a day/ daily
		yes, a couple of times in a week
		yes, less often than a couple of times in a week
		no, pet's teeth are not being brushed
		no, used to brush, but don't brush any more
12.	If your pet's teeth are brushed, then from where did you receive the advice or information that motivated you to brush? (please check all answers that apply) NB! Please answer this question ONLY if you responded with any of the YES answers to the question 11 (meaning your pet's teeth are being brushed), if you answered NO to question 11, please skip this question.	from a veterinarian (veterinary clinic)
		from a pharmacy
		from a pet shop
		from other dog or cat owners
		from the breeder of your pet
		from books
		from media/press
		from internet sources/web pages
		from elsewhere/other sources (please elaborate)
	
.....		
.....		
.....		
.....		
.....		
.....		
.....		

13.	If your pet's teeth are NOT brushed, then why? (please check all answers that apply) NB! Please answer this question ONLY if you responded with any of the NO answers to the question 11 (meaning your pet's teeth are NOT being brushed), if you answered YES to question 11, please skip this question.	Pet does not allow it
		You or your household members are unable to brush due to time commitments or physical issues
		You do not consider it necessary for the pet/ you think that the pet will not benefit from brushing
		You have not received advice recommending you to do it
		Something else (please elaborate)
14.	Do you (and how often) give your pet special products to support oral and dental health (eg. special foods, dental chews, food additives etc.)? (please choose one answer)	yes, at least once a day/ daily
		yes, a couple of times in a week
		yes, less often than a couple of times in a week
		no, my pet does not receive such products
15.	If you do NOT give your pet any special products to support oral and dental health, then why? (please check all answers that apply) NB! Please answer this question ONLY if you responded with NO to the question 14 (meaning you do not give your pet such products), if you answered YES to question 14, please skip this question.	They do not suit my pet (not palatable, cause digestive upset etc)
		You do not consider it necessary for the pet/ you think that the pet will not benefit from them
		You have not received advice recommending you to do it
		You don't consider it economically feasible (it's too costly)
		Something else (please elaborate)
16.	What types of special products to support oral and dental health do you give your pet? (please check all answers that apply) NB! Please answer this question ONLY if you responded with YES to the question 14 (meaning you do give your pet such products), if you answered NO to question 14, please skip this question.	oral gels/rinses
		drinking water additives
		feed additives
		dental chews/dental treats
		special dental foods
		Something else (please elaborate)

17.	<p>The <u>most preferred</u> type of special dental/oral health supporting product in case of your pet is (please choose one answer):</p> <p>NB! Please answer this question ONLY if you responded with YES to the question 14 (meaning you do give your pet such products), if you answered NO to question 14, please skip this question.</p>	oral gels/rinses
		drinking water additives
		feed additives
		dental chews/dental treats
		special dental foods
		Something else (please elaborate)
18.	<p>Please list those dental/oral health supporting products (product names) that you have given to your pet/used for your pet within last three months:</p> <p>NB! Please answer this question ONLY if you responded with YES to the question 14 (meaning you do give your pet such products), if you answered NO to question 14, please skip this question.</p>
	
	
	
	
	
19.	<p>Where do you purchase dental/oral health supporting products for your pet? (please check all answers that apply)</p> <p>NB! Please answer this question ONLY if you responded with YES to the question 14 (meaning you do give your pet such products), if you answered NO to question 14, please skip this question.</p>	from a veterinarian (veterinary clinic)
		from a pharmacy
		from a pet shop
		from a supermarket/grocery store
		from a webshop
		from elsewhere/other sources (please elaborate)
20.	<p>The <u>most preferred</u> place to purchase special dental/oral health supporting products for your pet is (please choose one answer):</p> <p>NB! Please answer this question ONLY if you responded with YES to the question 14 (meaning you do give your pet such products), if you answered NO to question 14, please skip this question.</p>	from a veterinarian (veterinary clinic)
		from a pharmacy
		from a pet shop
		from a supermarket/grocery store
		from a webshop
		from elsewhere/other sources (please elaborate)

21.	Where do you receive the advice/information from upon which you base your selection of dental/oral health supporting products for your pet? (please check all answers that apply) NB! Please answer this question ONLY if you responded with YES to the question 14 (meaning you do give your pet such products), if you answered NO to question 14, please skip this question.		from a veterinarian (veterinary clinic)
			from a pharmacy
			from a pet shop
			from other dog or cat owners
			from the breeder of your pet
			from books
			from media/press
			from internet sources/web pages
			from adverts
			from testing what my pet likes
			from elsewhere/other sources (please elaborate)
22.	Where do you receive or seek advice/information from regarding your pet's oral and dental health and care/prevention? (please check all answers that apply)		from a veterinarian (veterinary clinic)
			from a pharmacy
			from a pet shop
			from other dog or cat owners
			from the breeder of your pet
			from books
			from media/press
			from internet sources/web pages
			from elsewhere/other sources (please elaborate)
			I do not seek/ask or receive this information from anywhere
		23.	Which source where you receive or seek advice/information regarding your pet's oral and dental health and care/prevention from do you consider to be the most truthful and trustworthy? (please choose one answer) NB! If you answered the previous question (22) with „I do not seek/ask or receive this information from anywhere“, please skip this question.
	from a pharmacy		
	from a pet shop		
	from other dog or cat owners		
	from the breeder of your pet		
	from books		
	from media/press		
	from internet sources/web pages		
	from elsewhere/other sources (please elaborate)		

25.	Would you wish to receive more information and advice regarding your pet's oral and dental health and care/prevention?	yes
		no
26.	From where would you <u>prefer</u> to receive information and advice regarding your pet's oral and dental health and care/prevention? (please check one) NB! If you answered the question 22 with „I do not seek/ask or receive this information from anywhere“ or answered NO to the question 25, please skip this question.	from a veterinarian (veterinary clinic)
		from a pharmacy
		from a pet shop
		from other dog or cat owners
		from the breeder of your pet
		from books
		from media/press
		from internet sources/web pages
	from elsewhere/other sources (please elaborate)	
	
	
	

Please read through the following statements and choose whether in your opinion the statement is true (check yes) or false (check no).

28.	If a dog or a cat does not have dental calculus (tartar), then it is sure that everything is OK with their mouth and teeth.	yes
		no
29.	An unpleasant/ bad smell is normal in a dog's or cat's mouth.	yes
		no
30.	Daily toothbrushing is the most efficient way to prevent gum (gingival) disease in dogs and cats.	yes
		no
31.	A broken tooth is a problem for the pet and one should always seek veterinary attention in this case.	yes
		no
32.	Dental calculus (tartar) removal /teeth cleaning performed to an awake animal without general anaesthesia (without being 'put under' or 'put asleep') is beneficial and safe to a dog or a cat.	yes
		no

We thank you for your participation in the survey!

Appendix 2. Questionnaire for the owners in Estonian

Patsiendi ID/...../.....		Esmane visiit						
	<i>kliiniku ID / kuup. ppkkaa / patsiendi ID kliinikus</i>		Kordusvisiit						
Esmane kliinikusse pöördumise põhjus			KOER						
			KASS						
<i>ristita tabelis sobiv</i>									
Vanusaastatkuud VÕI sünniaeg/...../.....(pp/kk/aaaa)	KAAL VISIIDILkg							
		Ideaalkaal täiskasvanuna	<table border="1"> <tr><td></td><td><5 kg</td></tr> <tr><td></td><td>5-10 kg</td></tr> <tr><td></td><td>10-25 kg</td></tr> <tr><td></td><td>>25 kg</td></tr> </table>		<5 kg		5-10 kg		10-25 kg
	<5 kg								
	5-10 kg								
	10-25 kg								
	>25 kg								

Tõug (omaniku ütluse alusel)
.....

Küsimused omanikule : Palun vastake järgnevatele küsimustele Teiega kliinikus kaasas oleva lemmiku kohta. Märkige rist sobiva vastuse/vastuste ette kolmandasse, tühja tulpa.

Küsimustiku täitmisega nõustute osalema uuringus ja annate loa andmeid anonüümsel kujul analüüsida ja tulemusi üldistatud kujul avalikustada (nt. teadustöös). Kinnitame, et looma ja omaniku andmete kaitse ning anonüümsus on andmete käsitlemise ja analüüsimise käigus tagatud ning uuringu tulemusi esitatakse vaid üldistatud kujul. Täname Teid uuringus osalemast!			
1.	Milliseks hindate oma lemmiku suuõõne ja hammaste olukorda/tervist? (valige üks variant)		hea
			keskmine
			halb
2.	Kas olete märganud oma lemmiku suu juures järgmist (märkige kõik sobiv):		ebameeldiv suulõhn
			hambakivi ja/või katt hammastel
			igemetepunetus
			muu teie arvates normaalsusest erinev muutus (palun täpsustage)
			ma ei ole oma lemmikule suhu vaadanud
3.	Kas teie lemmikuga on teile teadaolevalt viimase aasta jooksul pöördunud loomaarsti poole seoses suuõõne või hammaste probleemiga või selle kahtlusega?		jah
			ei
4.	Kas teie lemmikuga on teile teadaolevalt varem kui viimase aasta jooksul pöördunud loomaarsti poole seoses suuõõne või hammaste probleemiga või selle kahtlusega?		jah
			ei

5.	Kas teie lemmikule on teile teadaolevalt viimase aasta sees teostatud loomaarsti poolt üldanesteesis (narkoosis, nn. magaval loomal) suuõõne hügieeniprotseduuri, nn. hambakivi eemaldamist/hammaste puhastamist?	jah
		ei
6.	Kas teie lemmikule on teile teadaolevalt varem kui viimase aasta sees teostatud loomaarsti poolt üldanesteesis (narkoosis, nn. magaval loomal) suuõõne hügieeniprotseduuri – nn. hambakivi eemaldamist/hammaste puhastamist?	jah
		ei
7.	Kas teie lemmikul on teile teadaolevalt kunagi eemaldatud hambaid loomaarsti poolt üldanesteesis (narkoosis, nn. magaval loomal)?	jah
		ei
8.	Kas teie lemmikule on teile teadaolevalt viimase aasta jooksul teostatud nn. hambakivi eemaldust/hammaste puhastust ilma üldanesteesiata (narkoosita, ärkvel loomal)?	jah
		ei
9.	Kas teie lemmikule on teile teadaolevalt varem kui viimase aasta jooksul teostatud nn. hambakivi eemaldust/hammaste puhastust ilma üldanesteesiata (narkoosita, ärkvel loomal)?	jah
		ei
10.	Kas teie lemmikul on teile teadaolevalt kunagi eemaldatud hambaid ilma üldanesteesiata (narkoosita, ärkvel loomal)?	jah
		ei
11.	Kas harjate oma lemmiku hambaid (või harjab neid keegi teine teie majapidamises)? (valige üks variant)	jah, vähemalt kord päevas
		jah, paar korda nädalas
		jah, harvem kui paar korda nädalas
		ei, lemmiku hambaid ei harjata
		ei, harjati varem, ent enam mitte
12.	Kui teie lemmiku hambaid harjatakse, siis kust saadud soovitus või info ajendas seda tegema (märkige kõik sobivad)? NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 11 (ehk teie lemmiku hambaid harjatakse), vastasel juhul jätke küsimus vahele.	loomaarsti juurest (loomakliinikust)
		apteegist
		loomaarsti juurest (loomakliinikust)
		teistelt koera- või kassiomaniikelt
		loomaarsti juurest (loomakliinikust)
		loomaarsti juurest (loomakliinikust)
		loomaarsti juurest (loomakliinikust)
		loomaarsti juurest (loomakliinikust)
		loomaarsti juurest (loomakliinikust)
		loomaarsti juurest (loomakliinikust)
loomaarsti juurest (loomakliinikust)		

13.	Kui teie lemmiku hambaid ei harjata, siis millisel põhjusel (märkige kõik sobivad)? NB! Palun vastake sellele küsimusele vaid siis, kui vastasite eitavalt küsimusele 11 (ehk teie lemmiku hambaid ei harjata või harjati kunagi, ent enam mitte), vastasel juhul jätkke küsimus vahele.	Lemmik ei lase
		Teil või pereliikmetel ei ole see ajaliselt või füüsiliselt võimalik
		Ei pea seda lemmikloomale vajalikuks/arvate, et lemmikule pole sellest kasu
		Ei ole sellekohast soovitusi saanud
		Muu (täpsustage)
14.	Kas ja kui tihti annate oma lemmikule suuõõne ja hammaste tervist toetavaid tooteid (nt. spetsiaalsed toidud, närimismaiused, söödalisandid vms.)? (valige üks variant)	jah, vähemalt kord päevas
		jah, paar korda nädalas
		jah, harvem kui paar korda nädalas
		ei, lemmik ei saa neid tooteid
15.	Kui te ei anna oma lemmikule suuõõne ja hammaste tervist toetavaid tooteid, siis millisel põhjusel (märkige kõik sobivad)? NB! Palun vastake sellele küsimusele vaid siis, kui vastasite eitavalt küsimusele 14 (ehk teie lemmik ei saab mõnda neist toodetest), vastasel juhul jätkke küsimus vahele.	Ei sobi lemmikule (ei maitse, tekitavad seedehäireid vms)
		Ei pea neid lemmikule vajalikuks/ arvan, et lemmikule pole neist kasu
		Ei ole sellekohast soovitusi saanud
		Ei pea majanduslikult võimalikuks (liiga kulukas)
		Muu (täpsustage)
16.	Millist tüüpi suuõõne ja hammaste tervist toetavaid tooteid te oma lemmikule annate/kasutate (märkige kõik sobivad)? NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 14 (ehk teie lemmik saab mõnda neist toodetest), vastasel juhul jätkke küsimus vahele.	suuõõne geelid/vedelikud
		joogivee lisandid
		toidulisandid
		spetsiaalsed närimismaiused/maiused
		eritoidud
		Muu (täpsustage)

17.	Kõige eelistatum suuõõne ja hammaste tervist toetavate toodete tüüp teie lemmiku puhul on (valige üks): NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 14 (ehk teie lemmik saab mõnda neist toodetest), vastasel juhul jätke küsimus vahele.	suuõõne geelid/vedelikud
		joogivee lisandid
		toidulisandid
		spetsiaalsed närimismaused/maused
		eritoidud
		Muu (täpsustage)
18.	Palun loetlege suuõõne ja hammaste tervist toetavad tooted (tootenimetused), mida olete oma lemmikule andnud/ oma lemmiku puhul kasutanud viimase kolme kuu jooksul: NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 14 (ehk teie lemmik saab mõnda neist toodetest), vastasel juhul jätke küsimus vahele.
	
	
	
	
	
19.	Suuõõne ja hammaste tervist toetavaid tooteid soetate te (märkige kõik sobivad vastused): NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 14 (ehk teie lemmik saab mõnda neist toodetest), vastasel juhul jätke küsimus vahele.	loomaarsti juurest (loomakliinikust)
		apteegist
		lemmikloomapoest
		tavapoest
		veebipoest
		mujalt (täpsustage)
20.	Kõige eelistatum koht suuõõne ja hammaste tervist toetavate toodete soetamiseks on teie puhul (valige üks): NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 14 (ehk teie lemmik saab mõnda neist toodetest), vastasel juhul jätke küsimus vahele.	loomaarsti juurest (loomakliinikust)
		apteegist
		lemmikloomapoest
		tavapoest
		veebipoest
		mujalt (täpsustage)

21.	Kust pärinevate soovitude alusel valite oma lemmikule suuõõne ja hammaste tervist toetavaid tooteid (märkige kõik sobivad vastused): NB! Palun vastake sellele küsimusele vaid siis, kui vastasite jaatavalt küsimusele 14 (ehk teie lemmik saab mõnda neist toodetest), vastasel juhul jätkke küsimus vahele.		loomaarsti/loomakliiniku soovitus
			apteekri soovitus
			lemmikloomapoe soovitus
			teistelt koera- või kassiomanike soovitus
			lemmiku kasvataja soovitus
			soovitus raamatust
			soovitus ajakirjandusest
			soovitus veebiallikast
			reklaam
			katsetan, mis lemmikule meeldib
			muu (täpsustage)
		
		
		
		
		
		
22.	Kust saate või küsite/otsite informatsiooni ja nõustamist oma lemmiku suuõõne ja hammaste tervise ja hoolduse kohta (märkige kõik sobivad)?		loomaarsti juurest (loomakliinikust)
			apteegist
			lemmikloomapoest
			teistelt koera- või kassiomanikelt
			lemmiku kasvatajalt
			raamatutest
			ajakirjandusest
			veebiallikest
			mujalt (täpsustage)
		
		
		
		
		
		
		
23.	Kust saadud informatsiooni ja nõustamist oma lemmiku suuõõne ja hammaste tervise ja hoolduse kohta peate kõige tõsemaks ja usaldusväärsemaks (valige üks). NB! Kui vastasite eelnevale küsimusele (22) „ma ei küsi/otsi või ei saa sellekohast informatsiooni kusagilt“, palun jätkke käesolev küsimus vahele.		loomaarsti juurest (loomakliinikust)
			apteegist
			lemmikloomapoest
			teistelt koera- või kassiomanikelt
			lemmiku kasvatajalt
			raamatutest
			ajakirjandusest
			veebiallikest
			mujalt (täpsustage)
		
		
		
		
		
		
		

25.	Kas sooviksite saada rohkem teavet ja nõustamist oma lemmiku suuõõne ja hammaste tervise ja hoolduse kohta?	jah
		ei
26.	Kust sooviksite <u>kõige eelistatumalt</u> saada teavet ja nõustamist oma lemmiku suuõõne ja hammaste tervise ja hoolduse kohta (valige üks)? NB! Kui vastasite küsimusele 22 „ma ei küsi/otsi või ei saa sellekohast informatsiooni kusagilt“, ja/või küsimusele 25 eitavalt, siis palun jätke käesolev küsimus vahele.	loomaarsti juurest (loomakliinikust)
		apteegist
		lemmikloomapoest
		teistelt koera- või kassiomanikelt
		lemmiku kasvatajalt
		raamatutest
		ajakirjandusest
		veebiallikatest
		mujalt (täpsustage)

Palun lugege järgnevaid väiteid ning märkige, kas teie arvates on väide tõene (jah) või väär (ei)

28.	Kui koeral või kassil ei ole suus hambakivi, siis tähendab see, et tema suu ja hammastega on kindlasti kõik korras.	jah
		ei
29.	Koeral või kassil on ebameeldiv / halb suulõhn normaalne.	jah
		ei
30.	Hammaste igapäevane harjamine on kõige tõhusam viis igemehaiguste ära hoidmiseks koeral ja kassil.	jah
		ei
31.	Murdunud hammas on lemmikule probleeme valmistav ja sellega peaks alati pöörduma loomaarsti poole.	jah
		ei
32.	Ilma narkoosita/üldanesteesiata ehk ärkvel loomale teostatav hambakivi eemaldus on koerale/kassile kasulik ja ohutu.	jah
		ei

Täname Teid uuringus osalemast!

Appendix 3. Non-exclusive licence for depositing the final thesis and opening it for the public and the supervisor's (supervisors') confirmation for allowing the thesis for the defence

Hereby I, **Mirella Hietakangas**
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21.05.19
Date

Toomas Orro
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