THE EQUINE MOUTH IN FIRST BASIC TRAINING

A Pilot Study on Icelandic Young Horses

MUNNUR HESTSINS VIÐ FRUMTAMNINGU

Forathugun á íslenskum tamningatrippum

Lokaverkefni til BS gráðu í reiðmennsku og reiðkennslu við Háskólann á Hólum

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Hér með lýsi ég því yfir að verkefni þetta er byggt á mínum eigin athugunum, er samið af mér og að það hefur hvorki að hluta né í heild verið lagt fram áður til hærri prófgráðu.

_____

(Christina Mai)

ABSTRACT

A pilot study was designed to assess morphological changes of the oral cavity of Icelandic youngsters during their first training phase, and to describe other reactions expressed by the horses when introduced to the headgear equipment. For ten weeks, eight horses were started with commonly used headgear equipment in Iceland, applying methods of first basic training practiced at Hólar University College. Three oral examinations were performed on the horses at the beginning, middle and end of the training period to assess the oral mucosa and the process of tooth shedding. Severe congenital abnormalities were observed in the tooth shedding in one horse that was consequently excluded from the study. Otherwise, the tooth shedding appeared to be in accordance with descriptions from other breeds in the literature. Thickening of the buccal mucosa was confirmed in three horses before training started, one with a mild lesion in this location. At the middle of the training period, comparable thickening was found in all horses except one, most likely as a reaction to pressure from the rope halter used during this period of training. At the end of the study, the buccal mucosa had in most cases normalized, while pressure reactions were now observed at the inside of the corners of the mouth in all horses, developing to a mild lesion in one case. These findings suggest that head gear equipment affects oral mucosa at predetermined locations, reflecting pressure points applied by the respective equipment. This happened without underlying abnormalities of the teeth. Care must be taken to avoid further development of these reactions to pressure lesions. Further reseach is needed to confirm these results and provide evidence-based preventive measures to maintain good oral health in the ridden horse.

ÁGRIP

Verkefni þetta er forathugun á þeim breytingum sem verða í munnholi hesta á meðan á hefðbundinni frumtamningu stendur og lýsir auk þess fyrstu viðbrögðum hesta við beislisbúnaði. Átta trippi á fjórða vetri voru frumtamin í 10 vikur með aðferðum sem kenndar eru við Háskólann á Hólum. Fyrst var eingöngu notaður snúrumúll en smám saman voru trippin vanin við mél og reiðmúla. Munnur trippanna var skoðaður þrisvar sinnum af dýralækni, í byrjun, um miðbik og í lok tímabilsins. Bæði var litið til slímhúðar í munni og tannskipta. Alvarleg vansköpun uppgötvaðist í einu trippi sem einkenndist af óeðlilegum tannskiptum og var tamningu á því trippi hætt. Að öðru leyti reyndust tannskipti vera í all góðu samræmi við það sem lýst hefur verið fyrir önnur hestakyn og tennur eðlilegar. Þykknun í slímhúð í kinnum var staðfest hjá þremur trippum áður en tamningin hófst og var eitt þeirra með smávægileg særindi í slímhúðinni á þessum stað. Um miðbik tímabilsins voru öll trippin nema eitt komin með slíka þykknun, líklega vegna þrýstings frá snúrumúlnum. Undir lok tamningatímabilsins var slímhúðin aftur orðin eðlileg hjá öllum trippunum. Þá varð hins vegar vart við þykknun í munnvikum hjá öllum nema einu trippi og má rekja þá breytingu til þrýstings frá mélum. Lítið þrýstingssár hafði myndast í einu tilfelli. Þessi athugun bendir til þess að múlar og mél hafi áhrif á slímhúð munnsins á fyrirfram ákveðnum svæðum sem endurspegla þrýstingspunkta sem notkun búnaðarins leiðir af sér. Þessar breytingar virtust óháðar tönnum hestanna. Mikilvægt er að tamningamenn geri sér grein fyrir þessum álagspunktum og leiti leiða til að draga úr þrýstingi á þeim og fyrirbyggja þar með þróun þrýstingssára. Frekari rannsókna er þörf til að ná þeim markmiðum.

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1. INTRODUCTION

Oral ulcers on the lip, tongue and the inside of the cheeks are very common disorders in horses worldwide (Allen, 2004) (Scoggins, 1989, p. 101) (Stubbs, 2004). Although oral ulcers can be caused by different reasons such as autoimmune, nutritional, neoplastic and traumatic aetiologies (Easley, 2005, p. 163), many are caused by the headgear equipment during the use of the horse (Tell et al., 2008, p. 410) (Bennett, 2001, p. 130). Statistics from about 60000 case books reveal that about 70% of all trauma in the oral cavity can be traced back to the use of the horse (Lundström & Wattle, 2008). Oral lesions are likely to cause discomfort or pain, although the patient does not always show obvious signs of oral pain (Tell et al., 2008, p. 406).

A study performed in Sweden by Tell et al. (2008) has shown that the most common mucosal lesion caused by the bit is located in the buccal mucosa adjacent to P1 and P2 and in close proximity to the corners of the mouth. In horses currently ridden with a bit and bridle, a significantly higher incidence of large and acute buccal ulcers in this area was found than in horses that had not been currently ridden. However, no significant difference was found between horses that were floated on a routine basis and those who were not. It was evident that the stress of headgear equipment and bits was causal to the development of these kinds of lesions.

Bit related injuries in the mouth were recently described in Icelandic competition horses and horses presented at breeding shows (Björnsdóttir, 2011 & 2012). Oral examinations of competition horses at the Icelandic championship 'Landsmót' in 2011 revealed pressure lesions in the oral cavity of 39% of the horses prior to the preliminary events. In 2012, comparable findings were found in 44% of the competition horses and 42% of the breeding horses. At the Icelandic Sports Championships 2012 similar figures were revealed with increasing proportion of serious injuries prior to the finals. These are alarming results. Concerned trainers and instructors will feel the need to reexamine both commonly used bits and riding techniques. Allen (2004) found buccal abrasions to be particular common in horses ≤ 5 years of age and questions whether important dental problems may be overlooked in many young horses. Tell et al. (2008, p. 410) did not find significant differences in the prevalence of oral ulceration between age groups. However, they suggest a larger study of younger horses to provide more information. In Icelandic breeding horses, the youngest horses, four years of age, were found to have the lowest prevalence of lesions in the mouth (Björnsdóttir, 2012).

No research has previously been done on oral health during the initial training of young Icelandic horses. In this period, the horses are worked with a bit for the first time in their lives and possible changes of the soft tissues of the oral cavity caused by the bit and headgear equipment are expected to be very clearly visible. During the starting of a young horse, its mouth changes its function and becomes part of the communication system between horse and rider. In Iceland, youngsters are commonly started at between three and four years of age. This is at the same time as the morphology of the skull changes dramatically, including tooth growth and shedding.(Gieche, 2007, p. 500).

The aim of this pilot study was to describe morphological changes in the oral cavity observed during the first training of young horses. Possible influences of headgear equipment, including the bit, on the health of the mouth, as well as the physical reactions of the youngsters when being bridled for the first time were assessed. Further, this study gives a literature review on some important aspects of the biology of the mouth, including current knowledge about the influence of bit and bridle on the oral cavity in ridden horses.

2. LITERATURE REVIEW

2.1 ANATOMY OF THE EQUINE MOUTH

During the starting of young horses, the role of the equine mouth changes dramatically. In order to understand these changes and the influences of the bit and headgear equipment, one must first be familiar with some important aspects of the equine oral anatomy.

2.1.1 ORAL CAVITY

The oral cavity is located between the cheeks in the rostral part of the horse´s head. The hard palate of the upper jaw bounds the oral cavity above and the lower jaw closes the oral cavity from down below (Figure 1).

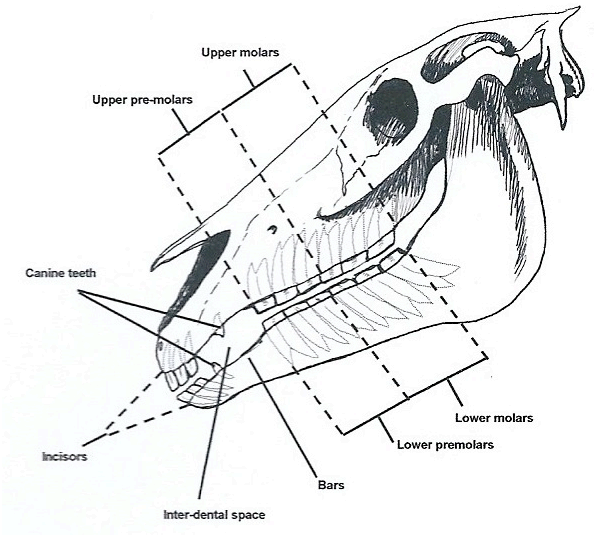

FIGURE 1- POSITION OF THE ORAL CAVITY BETWEEN THE UPPER AND LOWER JAW. SOURCE: THORODDSEN (2012). KNAPAMERKI 1, P. 28.

The upper jaw is the ventral part of the facial bone. Its hard palate extends from the incisors to the level of the last cheek teeth and is of almost equal width throughout. In the caudal end of the oral cavity the hard palate is followed by the soft palate, which separates the oral cavity from the pharynx (Figure 2). While the hard palate finds support in the bones of the skull, the soft palate only consists of soft tissue (Lundström, 2004, p. 12). The oral mucosa of the hard palate is covered with soft and pliable connective tissue that forms a wavy pattern (Holtappel, 1997, p. 13). Between the connective tissue and the hard palate lies a quite large venous plexus and there is actually no space left for the bit (Engelke & Gasse, 2002, p. 69). The depth of the hard palate varies with individual conformation and influences how easily the bit might press against it, possibly causing soreness and discomfort to the horse (Edwards, 2000, p. 120).

FIGURE 2- THE INSIDE OF THE ORAL CAVITY SEEN FROM IN FRONT OF THE MOUTH. COURTESY OF TORBJÖRN LUNDSTRÖM.

The lower jaw consists of two long bones, called hemimandibles, which carry the premolars and molars. They grow together in the rostral end of the mouth and form a bony floor to the oral cavity, carrying the incisors and canine teeth (Engelke & Gasse, 2002, p. 66). This floor is about 80 to 120mm long and makes it impossible for the tongue to yield downwards from pressure on the bit (Engelke & Gasse, 2002, p. 66).

The gap between the two hemimandibles is quite narrow as well, and Engelke & Gasse (2002, p. 68) claim that horses are not able to yield their tongues between the hemimandibles. Its depth and size influence how well the tongue fits in the oral cavity and consequently, how well a bit fits in, too.

Between the incisors and the cheek teeth is the interdental space, also called physiological interdental space, which makes it possible to place a bit in the mouth (Figure 3).

FIGURE 3- THE INTERDENTAL SPACE EXPRESSED ON AN X-RAY OF THE ORAL CAVITY. COURTESY OF TORBJÖRN LUNDSTRÖM.

The interdental space of the lower jaw is referred to as the bars. They are of great significance in the bridled horse, since the bit is mostly resting on the tongue and the bars. They are critically important for an effective and comfortable bitting, because they often form sharp edges and are only covered with a thin layer of oral mucosa. Their shape can vary among different individuals from narrow and sharp ridges of bone, only thinly covered, to flatter and heavily fleshed bars. The first example is exceedingly sensitive to bit pressure (Edwards, 2000, p. 119).

The oral mucosa mainly has a pink color that can vary in tone and intensity among different individuals or between different parts of the mouth. It also often shows pigmentation in the form of darker spots. The horny layer of the mucosa is significantly thicker in the hard palate

than in the lower jaw (Figure 4). The horny layer of the mucosa in the lower jaw is only two to three cell layers deep (Engelke & Gasse, 2002, p. 72), which makes it especially sensitive to mechanical stress, such as pressure or chafing from the bit. Engelke & Gasse (2002, p. 72) stress that this thin layer of oral mucosa is not sufficent to protect the bony edges from bit pressure.

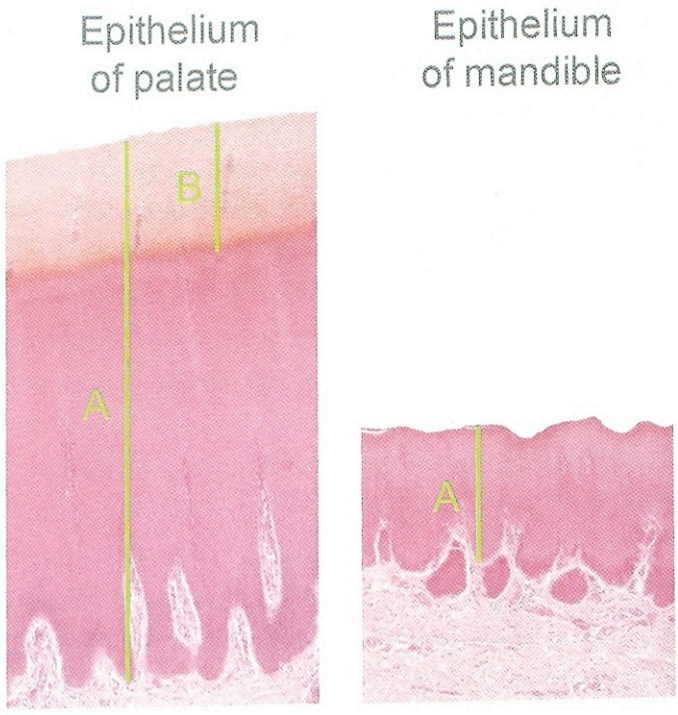

FIGURE 4- COMPARISON OF THE HORNY LAYER OF THE ORAL MUCOSA (B) OF THE HARD PALATE (LEFT) AND THE LOWER JAW (RIGHT). SOURCE: ENGELKE & GASSE (2002). DAS TRENSENGEBISS IM PFERDEMAUL - EINE ANATOMISCHE BETRACHTUNG, P. 73.

2.1.2 CHEEKS

The cheeks form the sides of the oral cavity. They consist of an outer skin layer, a muscle- and gland layer and a mucosa layer, which faces the inside of the oral cavity. The insides of the cheeks are prone to ulceration since the cheek pieces of the bridle or noseband can easily press the buccal mucosa against hard enamel on the cheek teeth.

2.1.3 LIPS

The lips of a horse consist of a larger upper lip and a smaller lower lip. They are highly mobile and are very sensitive and tactile organs (Nickel et al., 1973, p. 69). During rein pressure, the parts of the lower lip closest to the corners of the mouth can function like a pad for the bit, hereby protecting the sensitive bars of the lower jaw (Engelke & Gasse, 2002, p. 69).

Between the lips, the oral cleft extends to the level of the first cheek teeth. Compared to the length of the total oral cavity, the oral cleft is relatively small. This makes examination of the caudal parts of the oral cavity more difficult than in other mammals. The ends of the oral cleft are called the corners of the mouth and consist of muscle and membrane tissue (Holtappel, 1997, p. 11) (Nickel et al., 1973, p. 69). They are in steady contact with the bit.

Below the lower lip is the chin, whose skin can be affected by the noseband.

2.1.4 TONGUE

The tongue is a long and strong muscle, which occupies the inter-mandibular space. In the front it is spatular and highly mobile. Under the thick and keratinized mucosa of the body of the tongue is a median, fibrous cord, which consists predominantly of dense elastic fibers, interspersed with numerous adipose cells, and single or groups of cartilage cells (Nickel et al., 1973, p. 71). The soft tissue and muscles of the tongue are really flexible and ductile and able to make space for the bit by adjusting to it.

The tongue plays a significant role in the bridled horse, since it forms the biggest area of contact with the bit. When the horse accepts the bit, the tongue muscles relax and the bit gets indented, which takes the pressure of the bit off the palate (Clayton, 2005, p. 28). Further, the tongue is a highly sensitive organ and amplifies the received signals given by the rein (Engelke & Gasse, 2002, p. 69). It functions as a pad under the bit when pressure is applied to the reins, protecting the bars and their thin layer of oral mucosa (Holtappel, 1997, p. 11) (Engelke & Gasse, 2002, p. 69).

The size and form of the tongue varies significantly between individuals. Some horses have large, fleshy tongues while other horses of the same breed and age have much thinner and narrower ones (Edwards, 2000, p. 119). Since the tongue takes almost all the space in the oral cavity (Engelke & Gasse, 2002, p. 69), its form and size are of great importance for the choice of a correctly fitting bit. Although a thinner tongue might possibly leave more space for the bit inside the oral cavity, it might at the same time offer less protection for the bars during rein pressure. A thicker tongue overlapping the bars, on the other hand, is more likely to save them from direct pressure of the bit (Edwards, 2000, p. 119). Therefore, Edwards (2000, p. 119) suggests that the tongue formation and the type of bars decide what bit is best suited for a horse.

2.1.5 FACIAL NERVES

Bit, bridle and nosebands can influence the sensitive facial nerves of the horse, which are illustrated in Figure 5: The infraorbital nerve (a) is responsible for the upper jaw and nose, the branches of the mandibular nerve are responsible for the cheek (b), tongue (c) and lower jaw (d) with chin (d') and skin in the area of the masseter muscle (e), the ventral branch of the 2nd cervical nerve (f) is responsible for the mandibular space and the dorsal branch of the 1st and 2nd cervical nerve (g) is responsible for the neck (Geyer & Weishaupt, 2006, p. 599).

FIGURE 5- SENSITIVE NERVES (A- G), WHICH CAN BE INFLUENCED BY THE BRIDLE, BIT AND REINS. SOURCE: GEYER & WEISHAUPT (2006). DER EINFLUSS VON ZÜGEL UND GEBISS AUF DIE BEWEGUNGEN DES PFERDES- ANATOMISCH-FUNKTIONELLE BETRACHTUNGEN, P. 599.

The mandibular alveolar nerve supplies sensation to the lower teeth and gums within the mandible. The mental nerve is a branch of the mandibular alveolar and supplies sensation to the lower lip and chin (Kainer & Mc Cracken, 1994, p. 44). The bit often lies directly above the mental foramen and the terminal branches of the mandibular nerve (Cook, 1999, p. 203).

The facial muscles are supplied by the facial nerve (Figure 6, 20). Branches of it run across the surface of the well developed masseter muscle (Goody, 1983, p. 32) which is very important for mastication (Dyce et al., 1987, p. 475). These branches are visible superficially and they come in close contact with the bridle or the rope halter (Kainer & Mc Cracken, 1994, p. 43).

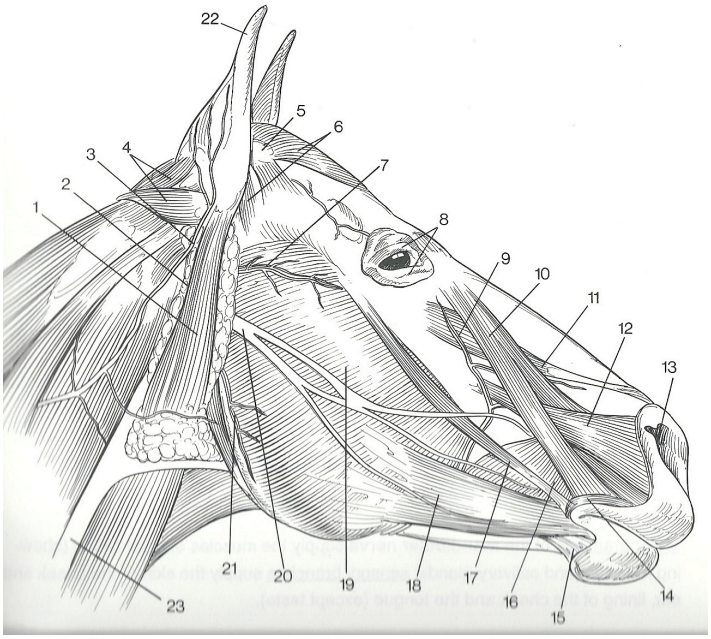

FIGURE 6- THE BRANCHES OF THE FACIAL NERVE (20) RUNNING ACROSS THE MASSETER MUSCLE. SOURCE: KAINER & MC CRACKEN (1994). THE COLORING ATLAS OF HORSE ANATOMY, P. 43.

2.2 THE EQUINE TEETH

2.2.1 DENTITION

Like all adult mammals, horses have four types of teeth, which are the incisors (I), the canines (C), the premolars (PM) and the molars (M). These different types of teeth each have certain morphological characteristics and specific functions: The incisors are designed for grasping and cutting the food and canine teeth evolved for defense and offense within the herd or against a predator. The cheek teeth function as grinders for mastication. In a natural environment, all of these are vital to the horse's survival (Gieche, 2007, p. 499).

Normal adult horses have 36- 44 teeth. There are twelve incisors (six upper and six lower) and 24 cheek teeth (twelve upper and twelve lower). The range in number is influenced by the presence or absence of canine teeth and wolf teeth, of which adult horses can have zero to four of each.

2.2.2 INCISORS AND CHEEK TEETH

The incisors are also known, respectively, as the central (I1), intermediate (I2) and corner incisors (I3) (Figure 7). Their length ranges from 5,5 - 7 cm.

The three big premolars (P2 - P4) and the three molars (M1 - M3) form a large continuous grinding surface (Figure 7). Together they are termed the cheek teeth and they are 8 - 10,5 cm long. They complete true longitudinal growth when the horse is six to seven years old and their exposed parts project about 1,5 – 2 cm above the gums (Nickel et al., 1973, p. 95). Both the incisors and the cheek teeth are hypsodont teeth, which erupt continually. Their crown is embedded within the jaw and extrudes only gradually (Dyce et al., 1987, p. 473).

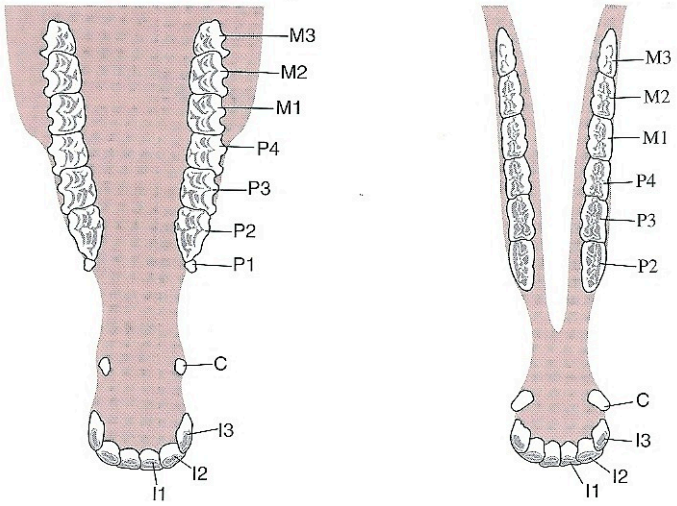

FIGURE 7- THE INCISORS, CHEEK TEETH AND CANINE TEETH IN THE UPPER JAW (LEFT) AND THE LOWER JAW (RIGHT). SOURCE: LUNDSTRÖM (2004). HÄSTENS TUGGSYSTEM, P. 16.

2.2.3 CANINE TEETH

The canine teeth are low, laterally compressed cones placed within the interdental space rather closer to the I3 than to the cheek teeth (Figure 7). They are brachydont (low crowned) teeth with sharp, enamel covered crowns, which wear away in old horses (Easley, 2004). Their embedded portions are disproportionately large in relation to the exposed crowns (Dyce et al., 1987, p. 474) and are strongly curved caudally (Nickel et al., 1973, p. 94).

Unlike the cheek teeth, the canine teeth do not continually erupt. There is no occlusal contact between the upper and lower canine teeth, because the lower canine teeth are more rostral than the upper canine teeth. That predisposes them for calculus accumulation (Dacre & Dixon, 2005, p. 172).

Canine teeth generally form in both sexes, but they often fail to erupt in mares, although they can be hidden under the thin layer of oral mucosa and cause pain when the bit pushes onto them. In such cases, their presence is often indicated by a prominence of the gum (Easley, 2004). It is also possible to observe hidden canine teeth by palpating the interdental space carefully (Engelke & Gasse, 2002, p. 65). Geldings and stallions, on the other hand, usually have larger, well- developed canines (Gieche, 2007, p. 498).

Erupting canine teeth in the four- to six-year-old horse can cause subgingival pain and bit irritation. So-called eruption bumps can now occur, which are painful on palpation and can become ulcerated. These are more commonly associated with upper canine teeth, where the overlying gingiva is loose (Easley, 2004).

Long, sharp canines in stallions or geldings can cause bitting problems, as well as displaced or grossly enlarged canine teeth. However, problems caused by the canine teeth are not very common in adult horses (Easley, 2004).

Since the root of the canine teeth lies close to the portion of the interdental space upon which the bit presses, its presence and its nerve supply might increase sensitivity for the bit. Cook (2003, p. 81).

2.2.4 WOLF TEETH

During equid evolution, the first premolars failed to molarize, either becoming small, relatively functionless teeth, or lost completely (Easley, 2004). These first premolars are also called wolf teeth, which are small (10- 20mm) brachydont teeth. Their roots can vary from 5-30 mm length (Dacre & Dixon, 2005, p. 173).

They are not present in all horses since they often fail to develop (Dyce et al., 1987, p. 474), or fall out without replacing when the animal is still young (Nickel et al., 1973, p. 95). At least one wolf tooth erupts in 40- 80% of domestic horses, the lower wolf teeth being much more rare (Johnson, 2010). When present in both upper and lower jaw, they never come in occlusion.

Some wolf teeth become angled rostrally and migrate under the mucosa as much as three centimetres rostral from P2. They are called ‘blind wolf teeth’ and can be detected by palpation of a hard nodule in the interdental space. These teeth often cause gingival pain or ulceration when coarse feed material or a bit push onto them.

Due to their placement in the interdental space right in front of the second premolar, wolf teeth can easily cause problems in ridden horses by interfering with the bit. Lower wolf teeth, blind wolf teeth or wolf teeth positioned rostrally in the interdental space are frequently contacted by the bit and cause pain and major training problems (Johnson, 2010). Normally placed, but enlarged wolf teeth may cause oral pain and buccal laceration due to bit contact, especially when the bit or the noseband force the cheeks onto occasional sharp protuberances of the wolf teeth (Dacre & Dixon, 2005, p. 173) (Johnson, 2010). Further, loose wolf teeth may shift under bit pressure and irritate the gum (Dyce et al., 1987, p. 474). Therefore, their presence is blamed for many behavioral problems (Dacre & Dixon, 2005, p. 173), such as, for example, notable unsteadiness in the mouth and the head itself during riding (Edwards, 2000, p. 118). Consequently, many experts advise to extract wolf teeth in horses that carry a bit.

However, Dacre and Dixon (2005, p. 173) remind that wolf teeth extraction is not necessarily an innocuous procedure, as all or part of their crown can be hidden beneath soft tissue and their crowns can be large and deeply embedded. Consequently, their extraction can cause damage to the hard palate and the enclosing soft tissues. Fractures of wolf teeth remaining after extraction can lead to permanent, painful, local swellings, which cause bitting problems that may not have been present before. The fact that normal sized and positioned wolf teeth have been found in older riding horses competing at a very high level, that have no history of bitting problems (Dacre & Dixon, 2005, p. 173), questions whether there should be a general rule for wolf teeth extraction. Maybe the decision whether to extract them or not should be made based upon their size and placement and whether they are loose or not, in order to avoid the above mentioned, possible complications. Anyhow, an extraction should always be done by an expert with proper equipment and under chemical sedation (Johnson, 2010) (Easley, 2004).

2.2.5 Tooth eruption and tooth shedding

A foal is born almost toothless and gets most of its deciduous teeth shortly after birth. The deciduous dentition counts 24 teeth. At an age of two years the first permanent teeth push through and the process of tooth shedding begins. The deciduous canine teeth are less than 0,5cm long spicules and do not erupt (Dixon, 2005, p. 40). The wolf teeth do not have deciduous counterparts. In some cases, they are shed during eruption of the permanent P2 (Griffin, 2009, p. 406).

The horse has a complete set of permanent teeth at the age of about six years (Edwards, 2000, bls. 117).

The formula of the temporary dentition in youngsters is $\frac{3-0-3}{3-0-3}$, while the formula for the permanent dentition in the adult horse is $\frac{3-1-3\ (4)-3}{3-1-3\quad -3}$ (Dyce et al., 1987, S. 473). Here, the upper and lower parts represent each half of the upper and lower jaw, respectively, giving the incisors, canines, premolars and molars.

Table 1 shows the time of eruption of both the deciduous teeth and permanent teeth. Individual variation in the timing of deciduous teeth shedding is reported (Dacre & Dixon, 2005, p. 174) and differences have been observed between different breeds and types of horses (Muylle, 2003, p. 37).

The deciduous teeth generally resemble the permanent teeth but are smaller and shorter in relation to their breadth. The deciduous incisors are much whiter than their replacements and constricted at the neck (Dyce et al., 1987, p. 475).

The development of the permanent teeth beneath the deciduous teeth hastens deciduous eruption, as the deciduous roots are resorbed due to continued pressure. The remaining part of the deciduous tooth is known as the cap. When this cap and the permanent premolar become clearly seperated at the gumline, the space in between becomes contaminated with food and bacteria. The blood supply and soft tissues now undergo necrosis and the cap falls off.

However, caps often have very sharp, needle- like spicules of enamel which remain stuck in the gingiva below the gum-line alongside the permanent tooth. This can make mastication quite painful (Stubbs, 2004) and cause short-term oral discomfort, especially when the cap is very loose and just partially retained by gingival attachment. Further, tooth shedding is often accompanied by temporarily inflamed gums, which is likely to cause discomfort for the horse and might be aggravated by the presence of a bit (Edwards, 2000, p. 119). Affected horses may display headshaking, quidding, resistance to the bit, and occasionally loss of appetite for a few of days, until the loose teeth are shed.

Deciduous teeth should not be removed without being digitally loose and protruding above the remaining occlusal surface, in order not to damage the permanent teeth (Dacre & Dixon, 2005, p. 175).

	Eruption of deciduous teeth	Eruption of permanent teeth (Shedding of deciduous teeth)
I 1	At birth or a few days later	2,5- 3 years
I 2	4- 6 weeks	3,5- 4 years
I 3	6- 9 months	4,5- 5 years
C	No deciduous conterparts	4- 6 years
P1	No deciduous conterparts	During first year of life
P 2	Shortly after birth	2,5 years
P 3		3 years
P 4		4 years
M 1	No deciduous counterparts	1 year
M 2		2 years
M 3		3,5 years

TABLE 1- TIME OF ERUPTION OF DECIDUOUS TEETH AND PERMANENT TEETH IN THE HORSE.

2.2.6 DENTAL PHYSIOLOGY

The dentition of the horse is suited for a diet of grass, which is a very abrasive material. Thus, a considerable attrition takes place at the occlusal surfaces and grinds down the cheek teeth by 2- 3 mm each year (Dyce et al., 1987, p. 473). To compensate for this loss, the greater part of the crown is initially embedded within the jaw and only gradually extruded. Delayed formation of the roots further allows the cheek teeth to grow for some years after they come into wear. Both cheek teeth and incisors have, additionally, high crowns to ensure a long working life (Dyce et al., 1987, p. 473). Because of this characteristic, equine teeth are called hypsodont.

A horse chews by moving the food caudally in a Z- pattern from side to side until it eventually reaches the pharynx (Lundström, 2004, p. 48).

2.2.7 SHARP ENAMEL POINTS

The occlusal surface of the cheek teeth contains the three dental substances enamel, dentine and cement. They wear at different rates, with enamel wearing at the slowest rate. Therefore, protruding folds of enamel are a normal feature in equine cheek teeth, providing an irregular

surface for grinding forage. They do not constitute an abnormality of wear, unless these ridges are excessively long or sharp (Dixon, 2000, p. 68).

Since the width between the two rows of cheek teeth in the upper jaw is greater than in the lower jaw, the angle of occlusion is sloped by approximately 10°- 15° (Figure 8). This can lead to sharp enamel points both on the outside edge of the upper cheek teeth and the inside edge of the lower cheek teeth (Nickel et al., 1973, p. 96) (Figure 9). A high percentage of tongue damage is caused by such lingual points on the lower cheek teeth (Stubbs, 2004). Additionally, buccal erosion adjacent to the upper cheek teeth, as shown in Figure 9, is a common finding (Dacre & Dixon, 2005, p. 167).

FIGURE 8- OCCLUSION OF THE CHEEK TEETH. SOURCE: GRIFFIN (2009). ROUTINE DENTISTRY IN JUVENILE PERFORMANCE HORSES, P. 406.

FIGURE 9- SHARP ENAMEL POINTS ON THE OUTSIDE OF THE CHEEK TEETH AND EXTENSIVE BUCCAL EROSIONS. SOURCE: GRIFFIN (2009). ROUTINE DENTISTRY IN JUVENILE PERFORMANCE HORSES, P. 412.

Therefore, removal of sharp enamel points has been a major component of dental care (Stubbs, 2004). Tell et al. (2008) claimed, however, that floating had no preventive value. According Dacre and Dixon (2005, p. 178), there is subjectivity in determining what size of enamel protrusion constitutes an overgrowth. According to Lundström 2010, sharp enamel points are often secondary to other, underlying reasons that need to be treated.

Sharp enamel edges can also occur on the rostral part of the first upper cheek teeth or on the caudal aspect of the last lower cheek teeth (Griffin, 2009, p. 411). Such overgrowths can cause damage to the soft tissue close to it and restrict the rostro-caudal movement of the lower jaw (Dacre & Dixon, 2005, p. 175).

Dental overgrowth can occur due to domestication, developmental disorders or dental disorders (Dixon, 2000, p. 68). In young horses, dental overgrowth can occur due to differential eruption of opposite teeth and should be treated as soon as possible in order to avoid further development of occlusal surface abnormalities (Dacre & Dixon, 2005, p. 179).

2.3 Natural function of the equine mouth

The oral cavity, or also called the masticatory system, is the first part of the digestive system of the horse. Food intake, mastication and further transport of the food take place here. Another really important role of the oral cavity for the health of the horse is to sort out foreign bodies that might have been taken in and prevent them from entering the cheek teeth and the rest of the digestive system. Especially since horses cannot vomit, the intake of undesirable or harmful material can be very dangerous. This sorting out takes place in the interdental space of the horse and unwanted or poisonous material can be spit out again, before moving deeper into the oral cavity (Lundström, 2004, p. 46). For this purpose, the interdental space is very rich in nerves and sensors. The bit itself feels in the beginning like a foreign body to the oral cavity and stimulates the reflex of spitting out unwanted food material.

Pressure on the gum causes the masticatory reflex to open the mouth and to swallow. Sensory pathways signal the brain to start mastication and invoke movement of the lips, the tongue and the jaw. Further, salivation is stimulated, and the horse produces more saliva (Cook, 1999, p. 198). Since the bit triggers these digestive tract reflexes, it gives the horse messages to eat and exercise at the same time, which are two mutually exclusive activities in nature. Further, these digestive tract reflexes are physiologically opposed to rapid breathing, which is sometimes required in training (Cook, 1999, p. 196).

However, the bridle is fastened firmly to the horse´s head and the mouth is in most cases held closed by a nose band. Therefore the natural reflexes of the oral cavity are suppressed, which might cause discomfort to green horses.

2.4. Effects of the bit and headgear equipment on the health of the mouth

2.4.1 Effects on the soft tissue of the oral cavity

The bit and bridle influence both the extra- oral part (lips and chin with its skin and hair) and the intra- oral part (teeth, tongue and oral mucosa) of the oral cavity and can affect the health of the horse´s mouth.

Problems caused by the bit often appear in behavior problems of the horse during riding. Affected horses often show tension, headshaking, open mouth, or try to move the tongue behind or over the bit. Horses have a natural tendency to push into pain (Scoggins, 2001, p. 138), and, therefore, actually often lean onto the bit when it is hurting them. Still, many horses do not show obvious signs of oral pain, enduring present injuries (Tell et al., 2008, p. 410).

When the bit moves within the oral cavity, it affects some tissue (Scoggins, 2001, p. 138). When pressure is applied to the rein, the bit moves laterally and/or from front to back and vice versa. This action moves the soft tissue before it moves the bit. Therefore, the pressure applied to the reins gets distributed to the soft tissue of certain parts of the oral cavity. One must not only consider pressure applied to the bit, but also to other headgear equipment like rope halters or riding halters, as they also apply pressure to the soft tissue of the cheeks or the oral cleft. Even without applying pressure to the reins, tightly attached nosebands apply pressure to the soft tissue each time the horse moves its mouth.

Whenever pressure is applied to soft tissue, its blood circulation gets limited. When the pressure is applied for a longer time or repeatedly, it can result in pressure lesions of the soft tissue (Lundström & Wattle, 2008). Pressure lesions are chronic and characterized by thickening of the soft tissue around, as described in Icelandic competition horses (Björnsdóttir, 2011 & 2012). As a reaction to such a pressure the tissue starts defending itself and hyperkeratosis or hypertrophy take place. When a lack of oxygen in the sub epithelial cell layer leads to necrosis in the epithelial cell layer and the tissue elapses, it results in the development of wounds or lesions (Lundström & Wattle, 2008) (Figure 10).

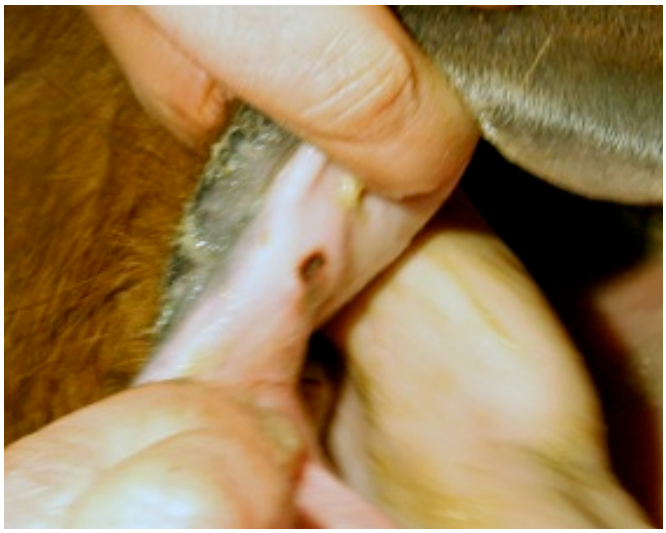

FIGURE 10- PRESSURE LESION IN THE SOFT TISSUE OF THE INSIDE OF THE CORNERS OF THE MOUTH. COURTESY OF HELGA THORODDSEN.

Abrasions are usually palpable. Thickened or firm areas can be sensitive to palpation, but not necessarily so (Scoggins, 1989, p. 101). Pressure lesions often occur when soft tissue gets trapped between the bit and the anterior surface of the lower P2. Due to the normal anatomy of the oral cavity, the area close to the corners of the mouth is prone to pressure concentration and its soft tissue can very easily get jammed (Lundström, 2010 a). This problem intensifies when common abnormalities, such as, for example, rostral hooks on P2, are present (Lundström, 2010 a). Because of their steady contact with the bit, the corners of the mouth commonly suffer from chafing, especially with a wrongly chosen or adjusted bit (Edwards, 2000, p. 120).

Other injuries caused by the bit and headgear equipment can be laceration of the tongue and lips and star fracture of the interdental space from bit pressure (Cook, 1999, p. 203). Laceration and very painful ulcers have been recorded under the mouthpiece of the bit (Scoggins, 1989, p. 101). However, these kinds of injuries are mostly related to complicated and rougher bits or inappropriate use of the reins and bad riding. They should not appear when correct training methods and suitable equipment are used.

2.4.2 SEVERITY OF PRESSURE LESIONS

The pressure lesions in riding horses are caused by steady, repeated pressure from the bit and headgear equipment. In fact, it is not only the amount of pressure that decides the severity of the damage caused to oral soft tissue, but mostly the frequency of its repetition.

Lundström and Wattle (2008) describe pressure lesions with the following formula:

Pressure lesions = Amount of pressure * frequency * tissue resistance

This shows that both the amount of pressure and its frequency influence the amount of damage. Further, each tissue has its own threshold for irritation to cause damage.

The formula shows that the frequency of pressure becomes more influential, the bigger the amount of pressure is. But on the other hand, smaller amounts of pressure can lead to big damage with high frequency.

The structure and composition of the area under the soft tissue (for example bone, tooth or muscle and smooth and even, or uneven and pointing out) is crucial. Soft, flexible surface underneath the soft tissue absorbs the pressure better than a hard surface and consequently decreases damage to the soft tissue from pressure applied to it.

2.5 Prevention

2.5.1 Evidence- based dental treatment instead of routine floating

In many countries it is common to routinely float a horse once or twice a year, in order to prevent oral injuries caused by equipment and the use of the horse. But, whether such routine treatments are appropriate is debatable - especially, if executed without a profound oral examination. Routine floating may provide a temporary relief but relapse is inevitable if the true causal condition is not treated in the correct way, making the physical effect of floating unenduring (Lundström, 2010 a). In addition, routine floating has the potential of failing to address underlying causes of oral pathology. All dental treatment should be evidence-based upon a thorough oral examination with appropriate, individual diagnostics and considerations. Routine floating that is not based upon proper oral examination can even exacerbate the development of dental problems, such as mobile or fractured teeth (Lundström, 2010 a).

The high prevalence of oral ulceration found in non-ridden, but prophylactically floated brood mares in the study of Tell et al. (2008) suggests that routine floating has a limited effect on the prevalence of oral ulcers in both ridden and unridden horses. When considering the common lesions of the soft tissue in the corners of the mouth in ridden horses, floating of the first cheek teeth might only be of temporary relief due to prevalence for pressure in this area.

Corrections of the equipment, on the other hand, could be a more successful way to avoid such lesions, especially when combined with a treatment that addresses the primary cause of the problem (Lundström, 2010 a).

Research of Andersson (2009, p.1) suggests that the effect of reducing enamel points by floating is only of short duration. However, the reduction of enamel, which is the main hard tissue for attrition, is permanent. One needs to bear in mind that repeated floating speeds up the wear of the teeth and shortens their functional lifespan.

Excessive floating (especially with power instruments) greatly reduces or even removes normal transverse ridges and enamel ridges, resulting in a flat and smooth occlusal surface, which is inefficient in feed consumption. Further, excessive rasping can expose sensitive dentinal tissues and cause pain and damage to the teeth (Dacre & Dixon, 2005, p. 179).

2.5.2 Regular change of headgear equipment

When different kinds of bits and equipment are used, the applied pressure on the oral soft tissues is different and it addresses different areas in the mouth. This method becomes clear when talking about nosebands: The Hanoverian noseband (Figure 11) exerts pressure to a different area of the mouth than the cavesson noseband (Figure 12).

FIGURE 11- HANOVERIAN NOSEBAND. COURTESY OF HELGA THORODDSEN.

FIGURE 12- CAVESSON NOSEBAND WITH A FLASH. COURTESY OF HELGA THORODDSEN.

Consequently, duration and frequency of stress exerted by the equipment become less for each area, when changing between both types of nosebands. Thus, the total amount of irritation or damage caused by the noseband becomes less for each area. The same happens

when different kinds of bits are used. Each bit exerts a slightly different kind of pressure on different parts of the mouth. Therefore, changing between different bits decreases pressure concentration on a particular area.

A five year retrospective study of 66 Icelandic horses executed by Gustafsson, Lundström and Wattle (unpublished) showed that the incidence of oral mucosal lesions went down from 77 to 20% by means of individual adjustment of bitting and increased variation of bits used, plus prophylactic dental care instead of the previously practiced routine floating.

To look for one certain, best fitting bit and noseband might be less effective in preventing damage to oral tissue, than changing between different kinds of equipment. Although one bit fits perfectly for a particular horse, pressure concentration is restricted to particular areas in the mouth which become prone to injuries. By changing the equipment regularly, pressure concentration is distributed to different areas of the mouth and therefore the damage on particular areas in the mouth becomes less. Further, soft tissue that got irritated during the last use of the horse, can recover when pressure and irritation are moved to another area during the next use.

Most wounds caused by the bit are superficial and heal rapidly, due to the extensive blood supply to the mouth and the antibacterial action of saliva. However, the continuous use of a bit disturbs healing since the damaged area gets irritated each time the bit moves (Bennett, 2006). Consequently, it might be necessary not to use a bit for some time to make recovery of oral injuries possible. A bitless bridle might be a good alternative in this case. However, severe injury to the tongue and the bars often leave a permanent defect (Bennett, 2006) and will therefore always interfere with the use of a bit.

2.5.3 Correct choice of the bit

The probability of oral injuries increases with improper selection, fitting, or use of a bit (Scoggins, 1989, p. 101).

The size and conformation of the oral cavity determine the right choice and fitting of a bit for a particular horse (Engelke & Gasse, 2002, p. 62) and influence how rein pressure on the bit affects different parts of the mouth (Holtappel, 1997, p. 12). Therefore, individual oral conformation plays a key role in maintaining oral health in horses worked with a bridle. Radiographic studies on the horse's mouth and bit position within it proved that mouth anatomy varies considerably between individuals, but those variations were not related to

overall size (Clayton, 2005, p. 28). Research of Engelke and Gasse (2002, p. 74) has shown such vast individual differences in particular oral anatomical characteristics, that it is not possible to determine the correct fitting size of a bit just by age or breed. Therefore, measurements of anatomical characteristics of the oral cavity might be of interest when choosing a bit for a particular horse. Clayton (2005, p. 28) suggests to consider the position of the corners of the lips relative to the bars, the width across the jaw between the corners of the lips on the left and right sides, the shape of the palate (flat or arched) and the thickness and width of the tongue.

When considering the thickness of a bit, one must consider the limited space that is left in the closed mouth for a bit (Clayton, 2005, p. 28) (Engelke & Gasse, 2002, p. 74) (Holtappel, 1997, p. 12) (Lundström, 2005). Many horses' oral cavities are in fact too small to accomodate thick bits, and such horses might be more comfortable with thinner bits. Further, a thick bit might stimulate more nerves in the interdental space than a thinner one and might therefore be less comfortable (Lundström, 2005).

The width of the mouthpiece should accommodate the width of the mouth at the corners of the lips. Accordingly Clayton (2006, p. 29) the bit rings or cheekpieces should be attached 12,7 mm (half an inch) wider than the horse's mouth. A too short mouthpiece will pinch the corners of the mouth against the cheek teeth, while a too long mouthpiece can easily shift the bit sideways and produce sawing on the lips, tongue and bars. A suitable width of the bit makes it lie steady in the mouth (Lundström, 2010b). This is very important for the accuracy of rein aids and the bit moves less under applied pressure, affecting less soft tissue of the oral cavity.

The type of bit also plays an important role, since different types of bits have different mechanisms of action and therefore affect different parts of the oral cavity. Radiographic studies of Clayton (2005) and Manfredi et al. (2005) show that the bit type affects pressure distribution on different oral structures and may affect the likelihood of injury to specific oral tissues.

2.5.4 Correct use of the bit

Training method and riding technique have a huge impact on the effects of bit and headgear equipment on the health of the mouth. The horse should be taught properly to understand all kinds of aids, so that the rider needs to rely less on the rein aids to communicate with his

horse. The accomplished rider uses his seat and legs before he uses the reins to communicate with his horse (Bennett, 2006).

Bennett (2006) emphasizes the importance of a good seat, which allows the rider to achieve soft, and sensitive hands, giving the rein aids in balance and exact control. The rein aids should always be fine-tuned, exact and as light as possible during all training phases.

Training and communication with the horse should rely on the principle of pressure and release (Bennett, 2006). The horse learns to give correct responses to the aids by seeking the comfort of pressure relief (Anderson, 2004, p. 6). Rein pressure must therefore be released or become less the instant the horse answers correctly. This also decreases the total amount of pressure executed on the oral cavity and its negative effects. Bennett (2006) also claims the importance of the concept of signal in training: A signal is the time between the moment the rider begins to exert pressure on the reins and the moment the bit starts to put pressure on the oral cavity. A well trained horse knows to recognize the initial increase in rein pressure and to respond before significant pressure is applied to the oral cavity.

The mental state of a horse influences how well it is listening to the aids and therefore it is a basic principle to work the horse in a calm and relaxed state of mind. The rider must gain the trust and full attention of the horse and be clear and fair with his aids.

Physical suppleness also influences the amount of rein aids needed to bend the horse both laterally and longitudinally and should be constantly achieved during training. This also addresses the natural crookedness in each horse, in order to prevent a significant onesidedness, which is likely to influence the health of the mouth during riding.

3. MATERIAL AND METHODS

3.1 HORSES

Eight Icelandic youngsters born in 2008 were used in this study, including two stallions, two mares and three geldings. When the study started, the youngsters were approximately 3,5 years old.

The number of horses was reduced during the research. The training of one mare was stopped rather early in the process as veterinary examination revealed physical weakness and abnormal development in tooth shedding. One gelding's training was not continued after the third week because he showed very poor character during training. Further, one stallion unexpectedly left the farm before research was finished. Thus, only five youngsters remained for the final oral examination.

Horse 1 was a calm stallion, who was very stiff in his body and found it difficult to bend and turn with the rider. He was stiffer to the left side.

Horse 2 was an especially calm mare, who learned very fast. She was quite stiff and it was difficult for her to bend the body to both sides. She was just slightly stiffer in bending to the right side.

Horse 3 was a rather pushy gelding who showed resistance during training. He seemed especially sensitive to the bit and showed a lot of head sheaking in the beginning. When the reins got attached directly to the bit, he became very tense, especially from pressure on the right rein. In general he was very sensitive and reacted to small aids. He was stiffer to the right side.

Horse 4 was a gelding who showed a lot of tension and difficult character. However, he reacted very well to the aids and was very sensitive to the rein aids. He was stiffer to the right side.

Horse 5 was a rather calm gelding, but a bit obstinate. He did not think forward under the rider and tried some mild bucking in the beginning. He was very insensitive to the rider's aids at first and needed stronger signals than the other horses. He was badly balanced in his body and took only right canter in the beginning. He was stiffer to the right side.

Horse 6 was a stallion with a lot of self confidence who tensed easily. Therefore his training progressed much slower than for the rest of the group. He left the training stable after six weeks and could therefore not be part of the last examination. He was stiffer to the right side.

Horse 7 was a gelding who showed a lot of tension and a very negative attitude towards any handler. Since he did not progress well and bucked the saddle for more than one week, his owner decided not to continue training because of his mental weakness and poor character.

Horse 8 was a mare who was not brought in for training because the veterinarian found a significant crookedness in one front leg during the first examination. She advised not to ride the mare, since this physical weakness

would likely cause lameness during training. Further, she showed abnormal development in tooth shedding, which would probably have caused problems with the bit.

3.2 HEADGEAR EQUIPMENT

3.2.1 ROPE HALTER

The rope halter used was of rather soft nylon material with one knot on each side of the front of its noseband and one knot on each cheek piece (Figure 13).

This type of rope halter is very commonly used in Iceland for the starting of young horses. It is supposed to be very strong and to offer good control of untrained horses. As the rope halter focuses pressure over a small area, it is less comfortable for the horse to lean into or pull against. The two knots on the noseband additionally act as pressure points, which can help get the attention of an untrained horse (Anderson, 2004, p. 31). During groundwork the rope halter was used in combination with a 4,5m long yachting rope, that can be both used for leading and one rein lunging. It gets attached to the halter by a heavy-duty, quick-release snap.

FIGURE 13- THE ROPE HALTER USED IN THIS STUDY.

3.2.2 BITS

During this study different bits were used. They are numbered and described as follows. The length of the bit was measured as the total length of the mouthpiece between the bit rings. The diameter of the mouthpiece was measured both at the middle joint and at the bit rings.

Bit 1: Single jointed full cheek snaffle

Material: Stainless steel

Length: 11cm

Diameter of the mouthpiece:

1,5 cm at the bit ring and 0,8 cm at the middle joint

Size of the rings: 4 cm

FIGURE 14- BIT 1.

A full cheek snaffle was chosen for the start of training, because its long prongs extending above and below the bit ring are supposed to prevent the bit from sliding through the mouth during one-rein stops. Further, the shanks assist in lateral bending by pressing up against the sides of the mouth and are supposed to help the youngster understand the sideways-working rein. Therefore, the full cheek snaffle is considered to be especially suitable for the starting of young horses and is commonly applied for this purpose (Uhlig, 2009, p.12).

Bit 2: Double jointed eggbutt snaffle with a rounded central spatula

Material: nickel- free brass

Length: 10 cm

Length of the middle piece: 3,5 cm

Diameter of the mouthpiece:

1,2 cm at the bit ring and 0,5 cm at the middle piece

Size of the rings: 7,5 cm

FIGURE 15- BIT 2.

The egg butt form is supposed to make the bit steadier in the mouth, because its attachment to the cannons does not allow rotation of the cannons around the rings (Manfredi et al., 2005, p. 197). The rather big diameter of the rings makes their straight parts longer, which keep assisting during lateral bending by pressing up against the sides of the mouth as the full cheek snaffle does. Further, there still is less danger of pulling the rings through the mouth during a one- rein stop.

Bit 3: Single jointed egg butt snaffle with thicker mouthpieces

Material: Stainless steel

Length: 11cm

Diameter of the mouthpiece:

1,8 cm at the bit ring and 0,5 cm at the middle joint

Size of the rings: 5,5 cm

FIGURE 16- BIT 3

This bit was only used a few times in order to change pressure distribution by using a thicker bit than bit 1 and 2.

3.2.3 NOSEBANDS

When the reins were attached directly to the bit, nosebands were used because it is considered helpful to teach the youngsters to accept the bit by limiting how much they can open their mouth. Another advantage of a correctly fitting noseband is that it helps to stabilize the bit in the mouth (Lundström, 2010b).

A cavesson noseband was used in combination with Bit 1 and a Hanoverian noseband in combination with Bits 2 and 3. The nosebands were attached in such a manner that the horses could still easily chew and open their mouth slightly.

3.3 STARTING THE YOUNG HORSES

3.3.1 TRAINING SCHEDULE

All youngsters had been handled previously and had been introduced to halter training and leading.

A young horse trainer who graduated from Hólar University College in 2009 worked the youngsters for ten weeks applying the method used during his studies at Hólar. This method concentrates on using both positive and negative reinforcement to teach new skills and to prepare the horses step by step for new demands.

The horses were gradually introduced to the equipment, the aids and the rider. New skills were first taught through groundwork both in the stable hall and in the round pen. The rider and his aids were introduced by leading and lunging with an assistant, riding them alone in the hallway and in the round pen, and finally following a companion horse both indoors and outdoors.

Once the horses had gained enough physical strength and were forward thinking, training in the indoor arena included more exact work on different track figures, bending and other work to make them supple, such as more demanding exercises like turns on the forehand and leg-yielding.

The horses were worked in all gaits. The horses that did not offer tölt by themselves, were introduced to the gait by walk-tölt transitions around the round pen. Table 2 gives an overview of the training schedule and of what equipment was used at a certain point in time.

The day after the final oral examination, the horses were presented to a recognized judge for young horse training from Hólar University College. He certified their training by both observing the horses when ridden by the trainer and by riding them himself. This test included standing still while mounting from both sides, walking on a long rein and with rein contact, stopping straight, turns on the forehand, leg yielding across the arena, trot on different track figures, canter on circles on both leads and tölt work depending on the individual gait distribution in each horse. The youngsters were jugded on their mental balance, their forward thinking, and their response to the aids.

Week	Training	Headgear equipment
1 (Examination 1)	Desensitizing, ground work, free lunging	Rope halter
2	Ground work, introduction of riding equipment, mounting with assistant	Rope halter Bit 1
3	Leading and lunging with rider, groundwork Introduction of rein aids Ridden alone on hallway: turns, one rein stop	Rope halter Bit 1 *Reins attached to rope halter*
4 (Examination 2)	Riding alone or with companion horse indoors and outdoors	Rope halter Bit 1
5	Riding indoors and outdoors	Rope halter Bit 1 Bit 2 Cavesson noseband
6	• Starting tölt • Stopping straight • More exact track figures, leg yielding exercises	Bit 1 Bit 2 Cavesson noseband Hanoverian noseband *Reins attached directly to the bit*
7, 8, 9		Bit 1 Bit 2 Bit 3 Cavesson noseband Hanoverian noseband
10 (Examination 3)	Riding test	

TABLE 2- OVERVIEW ON THE TRAINING SCHEDULE, POINT OF TIME OF ORAL EXAMINATIONS, AND EQUIPMENT USED.

3.3.2 INTRODUCTION OF THE BIT AND THE REIN AIDS

After some days of handling, a bridle with bit 1 was attached to the horses while being loose in their stalls for about five minutes, two days in a row. The next days, the horses were worked with a bridle and bit 1 in addition to the rope halter, but without having direct influence on it in the beginning. The bridle was attached over the rope halter in order to minimize the rope halter´s influence on the bridle and bit when pressure was applied to it (Figure 17).

Once the reins were used, they were attached to the nosepiece of the rope halter, which was put through the ring of the shank bit (Figure 18). Therefore, the pull on the rein first influenced the rope halter, and secondary pressure was applied on the bit.

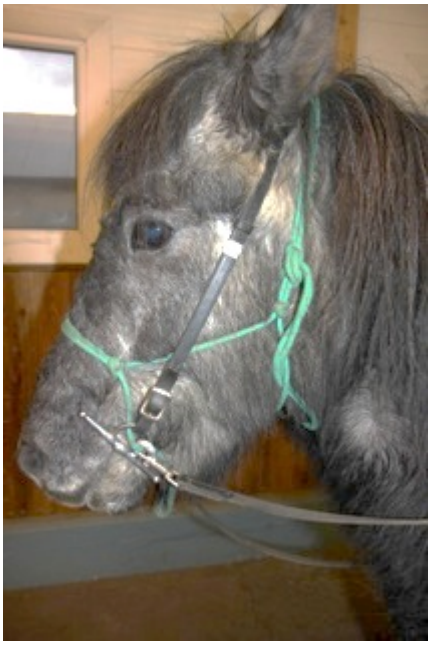

FIGURE 17- ATTACHMENT OF BRIDLE AND ROPE HALTER.

FIGURE 18- ATTACHMENT OF THE REINS THROUGH THE BIT TO THE ROPE HALTER.

The horses were introduced to the rein aids during groundwork with the trainer standing beside their neck and shoulder, pulling one rein lightly sideways. At this point in time, the horses had already learned to respond to side ways-leading pressure on the rope halter by flexing their necks in the same direction. When the horses gave in to the rein pressure and bent their heads following the direction of the rein, pressure was immediately released. The other rein was loose and provided the horse enough space to bend its neck. In the beginning, very small reactions of the horses in the right direction were already rewarded with pressure

release. Then, step by step, the horses needed to bend more to be rewarded. In the end they were supposed to flex their head towards their torso or the stirrups following the sideways-leading pressure on one rein.

This exercise is called “kissing the stirrup” (Appendix, Video 1) and prepares the horse for the one-rein stop. Further, it helps stretching the neck and improves suppleness in the horse. It makes the poll more flexible and relaxes the jaw and mouth of the horse (Thoroddsen, 2012, p. 38).

When a horse was not responding to the pressure on the rein, the rein aids were kept steady and soft, until the horse gave in. If a horse pulled against the rein, rein pressure was kept the same and released as soon as the horse answered correctly.

Once the horses had become familiar with the bit and the sideways-leading rein aids in groundwork, the same exercises were applied when mounted. In combination with driving aids the sideways-leading rein aids were used to control direction under the rider.

The reins were attached directly to the bit rings when the horses understood the rider’s aids correctly and responded to light aids. By then, they all had been ridden both indoors and outdoors and were mentally relaxed under the demands of the rider. The rope halter was now replaced by either a Hanoverian or a cavesson noseband. Soon, pressure was applied on both reins to slow down or halt the horse. A light and elastic rein contact on both reins was sought and the combination of the aids was introduced during bending and sideways- working exercises.

In general, this starting of the youngsters was characterized by as little use of rein aids as possible and more use of the seat, the leg aids and the voice. The rein aids in the beginning were only sideways, and one rein at a time. Flexion and one rein stops were used to control speed and direction. Further, the horses learned right from the beginning to yield their hindquarters to the leg aids, which gave the rider additional control over the horse. Instead of using the reins a lot to keep the horses on the required track in the riding arena, moveable fences or the whip were used to help the horse stay in the right direction. Additionally, a companion horse was used during the first trail rides to help the youngster understand where he was supposed to go.

3.3.3 ORAL EXAMINATIONS

Before the training started, all horses received an oral examination by a veterinarian. The health of the mouth, including the teeth, the lips, the tongue and the inside of the cheeks was examined and the process of tooth shedding was recorded. In order to observe possible changes in the oral cavity caused by handling and equipment, two more oral examinations were performed at the middle and at the end of training. Examination 2 was conducted after four weeks of handling and examination 3 was conducted at the end of the training period before the evaluation by the judge from Hólar University College.

In examination 1 and 3, the horses were sedated in their stables with 0.5 -0.7 ml of Dormosedan®. After approximately ten minutes, a full-mouth speculum was applied. The oral cavity was rinsed with water and examined both visually and digitally, using a bright light source. In examination 1 and 3 the following findings were recorded as being present or absent for each horse: abnormalities of soft tissue within the oral cavity, gingivitis, sharp enamel points on the cheek teeth, presence of wolf teeth and canine teeth, wear abnormalities, periodontal disease and dental fractures and presence of loose deciduous cheek teeth (‘caps’). Further the process of tooth shedding was recorded for each horse.

While eight youngsters were used in examination 1, only six remained for examination 2, which was performed without sedation and a mouth speculum. The mouth was kept open by holding the tongue out to the side. This assessment was less detailed than the first one and focused on visually assessing changes in the soft tissue and palpation of the rostral part of the mouth, such as the tongue, the inside of the rostral cheeks (P2-P3) and the inside and outside of the corners of the mouth. These parts were chosen because they are most likely to be influenced by pressure on the bit (Björnsdóttir, 2011 & 2012) (Tell et al., 2008, p. 409) (Scoggins, 1989, p. 101) and the rope halter. At that time of training, the horses had been worked for about 4 weeks in a rope halter and 2 weeks with the full cheek snaffle bit.

In examination 3, performed with sedation and speculum, a wooden bar covered in foam rubber was installed between the stall walls to improve the scope of the examination. The horses’ heads could now rest on top of this soft bar and were in a more lateral position and at a more suitable height for additional examination of the caudal end of the oral cavity. Examination 3 could therefore also assess the presence of the last molars and the presence of abnormalities in the most caudal space in the oral cavity.

3.3.4 Classification of pressure lesions

The classification of Björnsdóttir (2011) was used for subdivision of soft tissue lesions into three categories of severity:

1. Lesions of first degree are small and superficial lesions in the mucosa.
2. Lesions are classified to be of second degree when they either go through the mucosa or when they are still superficial, but large.
3. Lesions of third degree are extensive and deep.

3.3.5 Evaluation of individual natural crookedness

During the young horse training, the trainer subjectively judged natural crookedness in each horse by assessing to which side it was easier for the horse to bend. In the final exam, the judge from Hólar University College also assessed to which side it was easier for the horse to bend and yield.

4. Results

4.1 Examination 1

4.1.1 Abnormalities

Before the training started, thickening of the mucosa adjacent to P3 was recorded in two geldings and one stallion (Table 3). One of the geldings also had a 1st degree lesion in the same location. No abnormalities were found on the soft tissue of the tongue or the bars.

Extremely sharp enamel points were identified in two horses in correlation with eruption of P3, and one of these had a lesion in the soft tissue adjacent to them.

4.1.2 Process of tooth shedding

The process of tooth shedding was in good agreement with the literature (Table 3). The small differences identified between the eight individuals might have been due to slight differences in their age, probably one to four months. However, horse 8 expressed abnormal process of tooth shedding, being significantly delayed on the left side only.

In all horses the permanent I1 had erupted. In two horses I2 had erupted as well, while all had dI3. The canine teeth were erupting in two horses and were already present, but small in one horse. All horses had changed P2 except the mare that showed abnormal tooth shedding, with

dP2 still present on the left side only. P3 had erupted in six horses and two horses still had caps on P3. P4 had erupted in one horse and five horses had caps on P4.

Mild signs of gingivitis were seen in relation to the shedding of I2 or I3 in four horses.

Wolf teeth were found in six horses, being blind in one mare. They were all in the upper jaw, unilaterally in three horses and bilaterally in two horses. In three of the horses, the wolf teeth were rather loose and could be removed directly. In one horse the wolf teeth were removed later in the training period.

4.2 Examination 2

At this time five of the six examined horses, had some changes in the soft tissue of the inside of the rostral part of the cheeks, adjacent to P2 (Table 4). These findings were on the left side in 3 horses and on both sides in 2 horses, with the left side being worse.

Five horses expressed thickening of the oral mucosa and two of them additionally had lesions of first degree (vigour fibrosis) on the left side.

The chronic thickening of the inside of the right cheek of one stallion found in examination 1 was still present, but had become less. On the other hand, he had now a lesion of first degree in the mucosa adjacent to P2 on the left side.

4.3 Examination 3

All of the five examined horses had changes in the soft tissue inside the corners of the mouth. In three horses very small, point- like mucosal irritations were found, being on either the right or left side in two horses and on both sides in one horse (Table 3 in appendices).

In one horse the mucosal irritation was so small that it was almost not visible (left side). In one gelding, on the other hand, pressure lesions of first degree were found on both sides above and below the cleft. The size of the lesions was 2-3 m^2.

Only one horse still showed abnormalities in the soft tissue of the rostral cheeks. These were small pressure lesions of first degree on both sides, but more dominant on the right side.

Two horses had mucosal lesions in the caudal end of the oral cavity. These lesions were on both sides in one horse, but only on the right side and already in process of healing in the other horse.

No abnormalities were found in the tongue or the bars.

No sharp enamel points were found in any horse.

4.4 Evaluation of individual natural crookedness

Horse 1: Stiffer to the left side

Horse 2: Just slightly stiffer to the left side

Horse 3: Stiffer to the right side

Horse 4: Stiffer to the right side

Horse 5: Stiffer to the right side

4.5 Reactions to the bit when the horses were bridled for the first time

When the bridle with bit 1 was attached for the first time, the reactions of six horses were recorded. All horses showed intense chewing and opening of the mouth and white foam on the inside of the lips (Video 2). Some horses seemed more annoyed than others, showing head shaking and moving around in the box (Video 3).

The following reactions were observed in the given number of the six horses:

- Tense, fast chewing, licking and moving the bit with the tongue (6/6)
- Repeated, wide opening of the mouth (6/6)
- White foam on the inside of the lips (6/6)
- (Attempts to) scratch the head, bridle onto the wall (2/6)
- Repeated headshaking (3/6) (Video 3)
- Moving around in the stall (2/6)
- Pushing the tongue against the bit (1/6)

5. DISCUSSION

5.1 ORAL EXAMINATIONS

This pilot study gives insight into morphological changes in the oral cavity during the first basic training of Icelandic horses. Although based on few individuals under field conditions, the study shows knowledge of the oral cavity to be helpful for improving methods of starting horses during this very sensitive period in their physiological development. It also reminds trainers to look for congenital disorders, which may exist. The first examination was performed without sufficient support for the head of the horse, resulting in suboptimal position of the horse and the examiner. Therefore it was not possible to examine the most caudal part of the oral cavity that time. This demonstrated how important good conditions are for studies of the oral cavity, which preferably should be performed at a dental clinic. The second examination was designed only for identification of lesions in the mucosa on locations that might be affected by the headgear equipment used. The third examination gave more thorough information about the dentition and the mucosa in the caudal part of the mouth. Unfortunately only 5 horses were left in the study by that time.

5.2 PROCESS OF TOOTH SHEDDING

The process of tooth shedding has not been reported for the Icelandic horse. This must be regarded as very important information for horse trainers and should be studied in a representative quantity of horses. This study indicates that tooth shedding is mostly comparable to other breeds, although some variation was noted. Eruption of P4 and the canine teeth was found to be earlier than described in literature, as dP4 was already shedding in four horses, and P4 had erupted in two of them. The canine teeth were already present in one horse and erupting in three horses in this study. Eruption of M3, which is expected at the age of 3.5 years, seemed to be delayed in this group of youngsters since M3 had only erupted in one horse. Detailed information about the age of the horses in months would have been helpful for the interpretation.

The mucosal lesions in the caudal end of the oral cavity found in two horses in examination 3 are very likely indicating the beginning of the eruption of M3, since no abnormalities were found on the caudal molars. Due to their situation within the oral cavity, it is very unlikely that these lesions originated from headgear equipment or handling.

Signs of gingivitis were commonly seen in relation to shedding of the incisors and might indicate increased sensitivity of the oral cavity in youngsters. It can also result in mild bleeding from the mouth of horses at this age.

The fact that one out of eight horses in this study showed a significant abnormality in the process of tooth shedding stresses the importance of oral examination in youngsters. It further begs the question whether abnormalities in the process of tooth shedding are common in Icelandic youngsters, which demands further research. Undiscovered, such abnormalities are very likely to cause pain and difficulties during the starting of young horses, and may also affect performance later on.

5.3 Wolf teeth

The results of this study suggest that wolf teeth are common in Icelandic horses. Since they are likely to interfere with the bit and cause oral discomfort or pain, these findings emphasize how important it is to look for them in the very beginning of the starting process. The need for removing them should consequently be judged by a veterinarian.

5.4. Sharp enamel points

The findings of this study seriously question the prophylactic routine floating of youngsters commonly practiced in Iceland. Only two horses showed sharp enamel points on the cheek teeth. The veterinarian judged it necessary to reduce these enamel points in one horse only because of mucosal irritation close to it. There were no negative influences of the sharp enamel points found in the other horse. Therefore, the common, prophylactic floating of all cheek teeth in all youngsters would have been inappropriate and only have wasted their teeth.

5.5 Abnormalities of soft tissue of the oral cavity

Before training started, three horses showed abnormalities in the soft tissue of the inside of their cheeks. However, at that point in time the youngsters had been led in the rope halter for a few times.

The lesion in the buccal mucosa found in *horse 3* in examination 1 disappeared during the study without any treatment of the teeth. The origin of this lesion is not known for sure. One

possible cause might be pressure applied to the rope halter during leading, since the lesion is situated in the same area where the noseband of the rope halter is placed on the outside of the head (Figure 19). *Horse 3* showed a lot of resistance in the beginning and tried to escape from the handler during leading work. While a horse is trying to get free from a handler, strong forces are applied to the rope halter, which is in close contact with the cheeks. Once the horse is more trained, forces on the rope halter decrease during leading, and possible lesions can heal again.

FIGURE 19- PRESSURE APPLIED ON THE ROPE HALTER IN THE AREA OF THE PREMOLARS.

The inflammation and thickening of the buccal mucosa found in *horse 4* at examination 1 was partly still present at examination 2 and had disappeared before the third examination. This could also indicate that pressure from the rope halter caused the thickening of the oral mucosa, since it was not used anymore during the last weeks before the third examination. One might also consider the sharp enamel points on P3 as origin for the mucosal irritation. Since they got treated right after examination 1, their influence on the buccal mucosa disappeared. However, further examination after a longer period of time would be necessary, in order to see whether both the sharp enamel points and the mucosal irritation appeared again.

The findings in examination 1 in *horse 6* are of special interest, since the thickening of the mucosa was found to be chronic already before starting. The stallion had been running free in the pasture with another stallion for the last years. Consequently, it is very likely that playing and fighting between the two stallions had caused damage to the buccal soft tissue. This emphasizes the importance of oral examinations at the beginning of starting young horses. All abnormalities of the oral cavity can possibly get worse with the influence of bit and bridle and affect the horse's reactions to it.

The findings of examination 2 strongly imply that the use of a rope halter affects the health of the buccal mucosa within the oral cavity. All horses, except one, showed thickening of the buccal mucosa in the area where the nosepiece of the rope halter is situated on the head. At that point in time, the reins were still attached to the rope halter. Consequently, pressure on the reins was distributed onto the nosepiece of the rope halter (Figure 20), which likely pushed soft tissue against the premolars and caused irritation. The thickening of the buccal mucosa could be considered a natural adaptation to new mechanical stress resulting in more resistance.

FIGURE 20- REIN PRESSURE APPLIED ON THE ROPE HALTER IN LATERAL FLEXION TO THE RIGHT SIDE.

In examination 3, these reactions of the buccal mucosa had disappeared. At this time, changes of the oral mucosa were observed inside the corners of the mouth. This change might be explained by the change of headgear equipment between examination 2 and 3: The rope halter

was not used anymore after week five of training and the reins got attached directly to the bit rings. This led to a change in pressure concentration in the oral cavity, which might explain the new findings in examination 3. Now the corners of the mouth received most of the rein pressure, since they are in the closest contact with the bit rings. It is very likely that pressure on the reins made the bit move towards the premolars and pushed the soft tissue of the corners of the mouth onto P2. Since the Hanoverian noseband got introduced after examination 2, its influence on the soft tissue of the corners of the mouth might be of interest as well. The same Hanoverian noseband was used for all youngsters, and individual differences in oral anatomy among the horses might have influenced pressure exertion of the Hanoverian noseband on the soft tissue of the corners of the mouth.

However, the changes found in the soft tissue were very small. They were described as point-like thickening of the oral mucosa in most horses, but had developed into lesions of first degree on both sides in *horse 4*. These findings were especially striking because this horse had been very sensitive to the rider´s aids and had only been ridden with very light rein aids. On the other hand, *horse 5* needed to be ridden with significant more pressure on the reins, and this gelding did not show lesions of first degree. While *horse 4* was always in very light rein contact, *horse 5* often pushed and leaned onto the reins. These findings suggest that the amount of rein pressure might not necessarily correlate with damage to soft tissue of the oral cavity and other factors should be considered, too. For example, individual oral anatomy might have influenced how well the bits fitted into the horse's mouth and, following, how pressure on the reins affected the surrounding tissues. It might be of interest for future research to assess individual differences in oral anatomical traits in horses and put them in relation with effects of the bit on the oral soft tissues. Further, head carriage might influence how rein pressure is distributed on the soft tissue of the corners of the mouth, since *horse 4* tended to carry its head in a more vertical position than the other horses.

It must be mentioned that in the last weeks of research the youngsters learned more difficult skills, such as leg yielding, turning on the forehand and rein backing. Learning these skills often causes confusion in green horses since they combine driving and restraining aids. Due to lack of understanding many green horses push against the bit while learning the combination of aids. The rider must now keep the reins soft and still in order to let the horse understand the aids. Therefore, a lot of pressure can be exerted on the bit when the confused horse is pushing against the rein aids. The soft tissue might be more stressed during that phase

of learning and mucosal damage might be more likely to occur. However, once the horses have learned the new skills, rein pressure and stress on the soft tissue again decreases.

Finally it must be stressed that the majority of the mucosal irritations found in this study were mild and needed proper oral examination to be observed. The mildest ones can be regarded as a physiological adaptation of the soft tissue to provide protection against the new mechanical stress and do not necessarily need to develop into lesions. But this, however, is not known for sure and it would be necessary to follow up with these mucosal changes during further training. The fact that all horses showed changes in the soft tissue of the corners of the mouth at the end of the starting period, however, strongly implies that the bit and headgear equipment can easily affect the health of the mouth. It has to be taken into account that this training period was just the beginning. The horses will be trained further and higher demands on performance and rein connection will follow. Consequently, it is important to follow up with the findings in the soft tissue and try to avoid serious lesions in the future. Possible solutions might be both better selection of bit and headgear type and more regular changing of bits and nosebands. In this study, bit 2 was used more often eventually than bit 1 and 3, and it might be more effective to change more often between bits, with no bit being dominant.

Probably the bit should be introduced in a different way, such as every second day for a couple of weeks, instead of starting with everyday use.

These findings suggest that during the starting of young horses, the inside of the cheeks and the inside of the corners of the mouth seem to be most affected by the rein aids and headgear equipment. The fact that no abnormalities were found on the tongue or the bars, as often described in literature, might indicate that the demands of the starting of young horses do not affect the same areas of the oral cavity as more advanced horse training. During the first basic training, the youngsters are mostly ridden with one rein at a time, and no steady contact or head carriage is required. It might be of interest in further research whether the influence of the bit on the oral cavity changes with higher demands on steady rein contact, thoroughness, or collection.

Finally, the findings of this study show clearly that oral examinations are necessary in order to become aware of changes in the soft tissue within the oral cavity, and to be able to prevent severe damage in future riding horses. They further help us understand the impact of different types of headgear equipment on the soft tissues within the oral cavity.

5.6 NATURAL CROOKEDNESS

It was very striking that most changes of the oral soft tissue were found on the left side both in examination 1 and 2. In examination 1 two of three findings were recorded on the left side of the oral cavity. In examination 2 all horses showed changes of the soft tissue on the left side of the oral cavity, including *horse 6* showing more severe damage on the left side. In examination 3 no clear dominance of one side could be seen. The predominance for soft tissue irritations on the left side in examination 1 and 2 might possibly be influenced by natural crookedness in the horse, which makes it more difficult for it to bend to one side than to the other. The evaluation of natural crookedness of both the trainer and the judge from Hólar in this study does not always correspond with predominance of mucosal irritation on one side. Although, it must be mentioned that natural crookedness was only judged subjectively, and that it is often difficult to assess natural crookedness correctly in different horses. It can have many different underlying reasons.

In *horse 3*, *horse 4* and *horse 5* mucosal changes were found on the same side as was the easier one for them to bend to. This could indicate that more pressure is applied on the opposite side. These horses were stiffer to the right side and probably needed stronger rein aids to bend to this side. Consequently, the rope halter was pulled away from the head on the right side and pushed onto the left side of the head. This might explain why these three horses all showed changes of the oral soft tissue on the left side in examination 1 and 2.

Another interesting fact to consider is that the trainer was left-handed. Hence, she might unconsciously give stronger aids with her stronger left hand and apply more pressure on the left rein. When the reins are attached directly to the bit, this might result in more stress on the left part of the oral cavity.

When measuring the distance between the upper and lower jaw in the interdental space of different horses, Engelke and Gasse (2002, p. 75) found a clear asymmetry between the left and right side. Such natural crookedness in conformation might possibly influence quality of rein contact between the left and right rein, and explain a predominance in one side for mucosal lesions. Therefore, measurements on the distance between the upper and lower jaw on both sides of the interdental space might be of interest for further research.

This study is far too small to yield any conclusive remarks on a possible correlation between natural crookedness of the horse and a favored sidedness for oral damage within the oral

cavity. Further research on the natural crookedness and its possible influence on changes within the oral cavity is needed.

5.7 Response to the bit when the horses were bridled for the first time

The observed reactions of the horses when being bridled for the first time corresponded to the natural reflexes described in literature. The intense chewing and the additional production of saliva in all horses clearly reflected that the masticatory reflexes were set off by the bit. The wide opening of the mouth further demonstrated the reflexes that sort out foreign bodies from the oral cavity. The fact that the bit triggers these natural reflexes without satisfaction and remains fastened to the horse´s heads might explain certain stress and anger in some horses. Two horses even made attempts to rub the bridle off on the bars of the stall's wall and two horses walked in circles in their stalls. *Horse 3* showed very striking head shaking, which could also be seen in other horses in milder forms. Cook (2003, p. 81) claims the bit to cause headshaking by stimulating the trigeminal nerve and reminds us that the bit and bridle directly influence the facial nerves, causing additional discomfort.

These reactions of discomfort remind us that the interdental space is not at all made by nature to carry a bit. The horses should be introduced slowly to the bit and the first times it might be enough just to bridle a horse for a short time and let it get used to the bit itself, before aids are applied to it as well. Since the bit causes such strong irritation and discomfort in green horses, it is suggested not to bridle youngsters for the first time during training. This might disturb their focus, provoke training problems, and slow down the learning process. It still is questionable whether it helps youngsters to be fed while being bridled the first time, as is common in Iceland. This might rather reinforce the reaction of mastication and digestion to the bit in the mouth. The observation that no horse really closed his mouth while bridled, also proves clearly that there is not much space in the mouth for a bit. Additional food stuff in the oral cavity might not help the horse to accept the bit.

5.8 Reactions to the rope halter during leading for the first time

One mare was not pre-trained when this study started, and her response to the first use of the rope halter was recorded in Video 4.

Her reactions to pressure on the rope were significant chewing and opening of the mouth, as well as leaning into pressure. These reactions are typical for green horses and show that the rope halter already sets off natural, masticatory reflexes by asserting pressure onto the soft tissue of the horse's mouth. Further, the behavior of licking and chewing, which was observed, is regarded as a gesture of submission in equine body language (Roberts, 2002, p. 43).

The reaction of horse 8 to at first lean into the pressure is characteristic for horses. Similar reactions could be seen when the youngsters were taught the rein aids for the first time and pressure was exerted on the bit. When the trainer applied pressure on one rein, every horse stiffened against it at first. This is a typical reaction when starting young horses. Once pressure is applied, the first natural reaction of any green horse is to lean into the pressure. Training then teaches the horse to stop this reflex, which developed during the evolution of the horse for millions of years:

"Into-pressure is a response that the horseman needs to deal with when educating a horse to accept communication sent through the reins and the bit." (Roberts, 2002 p. 164).

5.9 Future research

Young horse trainers should have knowledge about the anatomy and the physiology of the mouth. That is a prerequisite for recognizing changes in the mouth of the youngsters and their relevance. Further, it is important to know about the influence of commonly used headgear equipment and to try to prevent damage to the oral cavity caused by its use. Knowledge always is the first step of preventing harm to the horse.

More research on the health of the mouth during the starting of young horses is necessary to see if the findings of this study are characteristic. Also, it might be of great interest to follow horses during further training to describe the following development and seriousness of possible mucosal irritations or lesions.

It is of great interest and necessity to assess the correlation between mucosal irritations and lesions and variables such as different types of equipment, regular change of equipment, head

position during riding, natural crookedness, and anatomical variation between individuals. Specific measurements of anatomical traits in different horses might be of interest in order to see whether individually adjusted choice and fit of headgear equipment can help prevent oral damage.

6. CONCLUSION

The findings of the study clearly show changes within the oral cavity of young Icelandic horses during the starting process. Succesive oral examinations during the starting process made it possible to see that the use of different kinds of headgear equipment, including the bit, affected the soft tissue of the oral cavity. The area of the inside of the cheeks and the inside of the corners of the mouth seem to be most stressed by the rope halter and the bit, respectively. The findings show that mild pressure lesions can already occur during the starting of young horses. Therefore, possible prevention of further development of such lesions must strongly be considered by trainers, since most horses will be ridden continuously throughout most of their life.

The oral examinations also clearly revealed the morphological changes of the oral cavity during the process of tooth shedding, which generally take place at the same time as starting Icelandic youngsters. The process of tooth shedding in the Icelandic horse seemed to be widely described in literature, but the canine teeth and P4 might possibly erupt earlier and M3 later than described in literature. Wolf teeth seem to be very common in the upper jaw in Icelandic youngsters of 3,5 years of age.

The observation of one horse with highly abnormal tooth shedding between the left and right side emphasizes the importance of oral examinations at the beginning of young horse training.

The described reactions of the youngsters to the bit when being bridled for the first time clearly show the natural reflexes that the bit triggers and its interference with the natural function of the oral cavity. Young horse trainers should bear in mind this change of natural function of the mouth, and especially follow up with its possible consequences on the health of the oral cavity.

The findings of this study suggest that all handling using any kind of headgear equipment, such as rope halters, bits, and bridles can affect the health of the oral cavity. Since the oral

lesions did not originate from abnormalities of the teeth, routine floating of young horses' teeth to prevent oral lesions, as widely practiced in Iceland, is strongly questioned.

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8. APPENDIX

	Horse 1	Horse 2	Horse 3	Horse 4	Horse 5	Horse 6	Horse 7	Horse 8
Abnormalities of soft tissue within the oral cavity	0	0	Lesion of 1. grade in the cheek (adjacent to left P2)	Inflammation and thickening of mucosa in the cheek (adjacent to left P3)	0	Chronical thickening of mucosa in the cheek (old) (right side)	0	0
Gingivitis	0	Around dI2 (left lower jaw) blood	0	Around dI3 (left lower jaw)	0	0	Around dI2 (right upper jaw) blood	Around dI3 (left)
Sharp enamel points on the cheek teeth	0	0	0	Sharp edge on P3 (left upper jaw)	0	0	0	Sharp edge with the gum on P2 in lower jaw
Presence of wolfteeth	2 (upper jaw) small	Blind (upper jaw)	2 (upper jaw) right one loose very big	0	1 (right upper jaw)	1 (left upper jaw), loose	0	1 (left upper jaw) loose small
Presence of canine teeth	Erupting	Erupting	0	0	0	0	x small	0
Erupted permanent teeth **I1**	x	x	x	x	x	x	x	x
I2	shedding	shedding	x	in lower jaw	0	x	0	Only left side
I3	0	0	0	0	0	0	0	Shedding on left side
P2	x	x	x	x	x	x	x	Right upper jaw long ago, Cap on left upper jaw
P3	newly	x	x	newly	cap	x	x	2 caps
P4	cap	cap	Left upper jaw Right upper jaw: cap	0	cap	newly	cap	0
Other remarks	Unusual big P2			Seems less proceeded in tooth shedding than rest of the group		More proceeded in tooth shedding than rest of the group	Brown colouring of incisors	Unnormal development between left and right side less proceeded in shedding of premolars on left side

TABLE 3- FINDINGS IN EXAMINATION 1 BEFORE THE START OF TRAINING FOR EACH HORSE CONSIDERABLY.

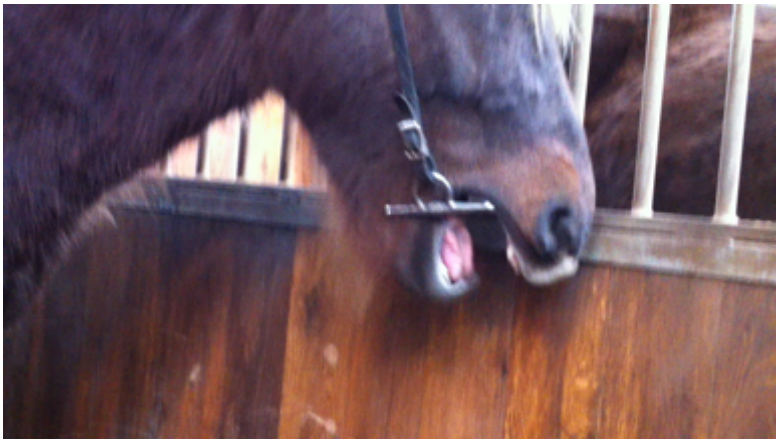
	Horse 1	Horse 2	Horse 3	Horse 4	Horse 5	Horse 6
Rostral part of the cheeks	Very little, pointlike thickening of the soft tissue adjacent to P2 (left side)	Very little thickening of the soft tissue adjacent to P2 (right side) Small lesion (vigour fibrosis, self defense thickening) adjacent to P2 (left side)	No findings	Very little thickening of the soft tissue adjacent to P2 (left side)	Little thickening of the soft tissue adjacent to P2 (left side)	Thickening of the soft tissue adjacent to P2 (right side): Less than in examination 1 Pressure lesion of 1. degree (left side)

TABLE 4- FINDINGS OF EXAMINATION 2 AFTER FOUR WEEKS OF TRAINING FOR EACH HORSE CONSIDERABLY.

	Horse 1	Horse 2	Horse 3	Horse 4	Horse 5
Abnormalities of soft tissue within the oral cavity **a) Inside of the corners of the mouth**	Very small, pointlike mucosal irritation (size of a needle´s head) (left)	Very small, pointlike mucosal irritation (right side)	Very small, almost not visible, mucosal irritation (left side)	Mild pressure lesions, not reaching through mucous membrane Largest lesion: 2-3 mm^2 (both sides, above and below cleft)	Small, pointlike irritations with unsevere swelling (both sides, but more on right side)
b) Inside of the cheeks adjacent to P2	0	Small, mucosal lesions (both sides, but more dominant on right side)	0	0	0
c) Caudal end of oral cavity	0	Mucosal lesions behind the molars (both sides)	0	Very small mucosal lesion behind the molars, in process of healing (right side)	0
Gingivitis	0	Around canine teeth (blood)	0	Around dI2 (upper jaw)	Around dI2 and dI3 (upper jaw)
Sharp enamel points on the cheek teeth	0	0	0	0	0
Presence of canine teeth	Missing data	Erupting	Shedding	0	0
Erupted permanent teeth **I1**	x	x	x	x	x
I2	newly	x	x	shedding in upper jaw	0
I3	0	shedding	0	0	0
P2	x	x	x	x	x
P3	x	x	x	x	Missing data
P4	cap on right side	Missing data	x	x	x
M3	Missing data	0	Erupting	0	0
Other remarks		No abnormalities in last molars	Sloping bite because of cap on P4 on right side only		

TABLE 5- FINDINGS OF EXAMINATION 3 AFTER TEN WEEKS OF TRAINING FOR EACH HORSE CONSIDERABLY.

VIDEO 1- KISSING THE STIRRUP. HTTPS://WWW.DROPBOX.COM/S/47NSGG1KU6LELOL/IMG_0786.MOV.



VIDEO 2- PHYSICAL REACTIONS OF THE HORSES WHEN BEING BRIDLED FOR THE FIRST TIME.
HTTPS://WWW.DROPBOX.COM/S/9IYZ43QIERGVSIL/IMG_0781.MOV

VIDEO 3- MORE INTENSE, PHYSICAL REACTIONS TO THE BIT OF HORSE 3 WHEN BEING BRIDLED FOR THE FIRST TIME:
HTTPS://WWW.DROPBOX.COM/S/G7U7IVBSO1GVOGR/IMG_0772.MOV

VIDEO 4- REACTIONS OF HORSE 8 TO THE ROPE HALTER WHEN BEING USED FOR THE FIRST TIME:
HTTPS://WWW.DROPBOX.COM/S/XTC6FBYRCDM87PH/IMG_0763.MOV