

Analysis of the relationship between occlusal and clinical parameters and the need for incisor reduction in confined horses – a retrospective study

Análise da relação entre parâmetros oclusais e clínicos e a necessidade de redução de incisivos em equinos estabulados – estudo retrospectivo

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ABSTRACT

The purpose of this retrospective study was to evaluate the relationship between occlusal and clinical parameters and the need for incisor shortening in horses. It was based on the retrospective analysis of the dental charts of 75 confined horses. Body condition score, shape of incisors, presence of dysmastication, excursion to molar contact (EMC) distance before and after cheek teeth occlusal adjustment were evaluated. History of difficult to riding, dysmastication and digestive problems was also considered. The initial measurement of lateral excursion to molar contact (EMC) revealed incisor occlusal surface abnormalities in 45 (60%) horses and long incisors (EMC>15mm) in five (6.6%) horses. Considering clinical examination and history data the need for reduction of incisor length was significant when EMC exceeded 15mm ($P<0.0001$) and when based on dental shape, clinical history of dysmastication and/or digestive problems or body condition score was also significant ($P<0.05$). In confined horses, the decision to shorten and align the incisor teeth should be based on observation and history of dysmastication and digestive problems, body condition score, incisors shape and EMC distance. The need for incisor reduction should be determined before dental intervention and reassessed following cheek teeth occlusal adjustment.

Key words: equine dentistry, equine malocclusion, equine incisor shortening, equine digestibility, confined horses.

RESUMO

O objetivo deste estudo foi avaliar a relação entre parâmetros clínicos e oclusais e a necessidade de redução de dentes incisivos de equinos. Este estudo foi baseado na análise retrospectiva dos odontogramas de 75 cavalos estabulados. Foram analisados o escore corpóreo, o formato dos incisivos, a presença de disfagia, a extensão da excursão lateral da mandíbula no ponto de início do contato molar (ELCM) antes e após o ajuste oclusal molar / pré-molar (M/PM). Foram considerados os históricos de dificuldades de equitação, problemas digestórios e mastigatórios.

O exame inicial revelou anormalidade de oclusão em 45 (60%) equinos e incisivos longos (ELCM>15mm) em 5(6,6%). Após o ajuste oclusal M/PM, mais 14 (18,6%) equinos apresentaram ELCM >15mm. Considerando-se os parâmetros oclusais e clínicos em conjunto, foi significativa a necessidade de redução dos incisivos quando a ELCM foi maior que 15mm ($P<0.0001$). A análise individual da presença de distúrbios de oclusão de incisivos, do escore corpóreo magro e regular, da presença e histórico de disfagia e do histórico de dificuldades na condução a necessidade de redução de incisivos com ELCM>15mm foi significativa ($P<0.05$). A decisão de redução do tamanho de dentes incisivos em cavalos confinados deve ser baseada na observação e histórico de disfagia e problemas digestórios, escore corpóreo, formato dos incisivos e na extensão da ELCM. A necessidade de redução dos incisivos deve ser determinada antes e reavaliada após o ajuste oclusal molar/pré-molar.

Palavras-chave: odontologia equina, malocclusão, redução de incisivos de equinos, digestibilidade, equinos estabulados.

INTRODUCTION

The equine species has involved as continuously grazing and free ranging animal usually eat 12-18 hours daily in sessions lasting 30-180 minutes. The hypsodont horse's teeth erupt throughout life at 2-3mm per year to equalize the natural occlusal wear, from gridding and cutting forage with a high concentration of biologic silica. Confined horses, which have no access to pasture do not use the incisor teeth for shearing, and this may lead to incisor overgrowth because of the lack of attrition and which causes malocclusion over time due to reduced wear of dental occlusion surfaces and

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restricted range of mandibular excursion. Given the maintenance of rate of eruption, the incisors become excessively long and interfere with normal grinding and masticatory function of molars and premolars (SCHUMACHER & MAIR, 1986; RUCKER, 2006; DIXON & DACRE, 2005; EASLEY, 2011).

A study involving 56 pasture-raised pregnant mares, aged between three and 18 years, that were confined two days previous to dental intervention compared data collected before and after dental intervention and reported no significant differences on nutrient digestibility, weight gain and body condition scores (CARMALT, 2004). However, a second study with four non-pregnant mares and nine geldings used by the mounted police and kept in confinement for over one year showed increased digestibility of dry matter, crude protein, crude energy, neutral detergent fiber, acid detergent fiber and lignin (PAGLIOSA, 2004). A retrospective study evaluating the possible causes of chronic weight loss in 60 horses suggested that dental conditions may be involved in 20% of cases (TAMZALI, 2006).

Abnormalities of incisors have been blamed for causing difficult mastication and decreased performance. Incisor abnormalities have been separated into five classes: 1-Excessively long incisors arcades from lack of occlusal contact and/or wear; 2-Smile bite, or dorsal curvature of incisor arcade; 3-Frown bite, or ventral curvature of incisor arcade; 4-Diagonal bite with or without an offset jaw and 5-Stepped or irregular incisor bite (RUCKER, 2004; DELOREY, 2008; EASLEY, 2011).

Incisor alignment is indicated in cases of abnormal incisor arcades (incisor smile, frown or slant) or in the presence of steps precluding lateral mandibular excursion, promoting abnormal wear of cheek teeth. Incisors that are normal in shape and occlusion, but are too long from lack of wear, should be shortened to allow additional (normal) cheek teeth occlusion (DIXON et al., 1999; SCRUTCHFIELD, 2006; DELOREY, 2008).

The combined incisor teeth surface area corresponds to less than 8% of the combined cheek teeth surface area. Also, incisor teeth are composed mainly of type II enamel that is less resistant to wear than type I enamel, the major component of cheek teeth. Hence routine reduction of incisor length to limit "excessive incisor growth" that might impair cheek teeth occlusion cannot be justified on the basis of dental anatomy alone (DIXON et al., 1999).

Tooth wear is a complex process that depends on the type of diet, hard matter (waste) ingestion, masticatory pattern, tooth size, relationship

between the occlusal surfaces of antagonist teeth, dental structure and possibly behavior (KILIC et al., 1997).

A study suggested that 10-20% of horses requiring cheek teeth occlusal adjustment also require incisor shortening or alignment (RUCKER, 2004). However, a different study reported that shortening or alignment of the incisors is required in less than 5% of horses following correction of cheek teeth occlusion abnormalities (DIXON et al., 1999; SCRUTCHFIELD, 2006).

The technique to correct overlying long incisors involves reducing the exposed crown height of the long teeth. How much incisors should be removed are estimated by the distance between the occlusal surfaces of the upper and the lower cheek teeth arcades (SCRUTCHFIELD, 2006). Another method used is based on using trigonometry and measuring the lateral excursion to molar contact (EMC) and incisors elevation, a fairly accurate estimate of incisor reduction can be determined (RUCKER, 2004; EASLEY, 2011). The author of this method has measured the distance that mandible moves laterally to molar contact (EMC) in 730 horses from 1 to 27 years old. The mean distance was $12 \pm 3,1$ mm. The author suggested that horses with EMC below 15mm do not require incisor shortening given there is adequate cheek teeth occlusion during mastication (RUCKER, 2004).

How the tooth wear may be influenced by multiple factors, the decision to shorten the incisor teeth must be based on more than one clinical or occlusal parameter. The purpose of this retrospective study was to evaluate the relationship between occlusal and clinical parameters and the need for incisor shortening in horses with EMC greater than 15mm kept in confinement for over one year.

MATERIALS AND METHODS

The dental charts of 75 healthy horses (*Equus caballus*) of both genders, aged between six and 17 years, weighing between 470 and 650kg and submitted to dental examination were evaluated. All horses included in the study had been in confinement for more than one year and were used either as sport (jumping, dressage or cutting) or exhibition horses, with a mean routine training of five to six days/week. The dental charts of horses with skull asymmetry and missing teeth were excluded of this retrospective study. The dental charts with historical of under nutrition, systemic disease and chronic weight loss syndrome also weren't included in this retrospective

study. The following parameters were evaluated: body condition score, incisor teeth format, EMC distance (before and after cheek teeth occlusal adjustment) and observed dysmastication (abnormal, slow or intermittent mastication, drop of food from the mouth or quidding). History of inadequate response to riding commands, dysmastication, weight loss or difficulty to gain weight and colic during the 90 days previous to initial dental examination was also considered.

Evaluation of body condition score was based on an adaptation from the method described by EASLEY (2011), where the ranges for thin, regular, good and obese are between one and three, four and five, six and seven and eight and nine respectively. Body weight was estimated using a weigh tape. Incisor alignment was evaluated using a Bussico gauge (World Wide Equine Inc.) inserted between the occlusal surfaces of the incisor teeth (Figure 1).

Measurements to determine the occlusal contact relationship between incisors and cheek teeth were performed. The EMC was evaluated with the head in neutral position. Measurements were taken from the right and the left sides and repeated three times in each horse to determine the average distance of EMC. Before incisors adjustment the cheek teeth were floated and wear abnormalities were corrected. The EMC measurements were repeated to check the balance between cheek teeth hemi arches and changes in EMC. According to the literature who suggested that horses with EMC below 15mm do not require incisor shortening given there is adequate cheek teeth occlusion during mastication, after cheek teeth adjustment, we considered that the EMC was measured should be less than 15mm.

Horse owners and riders were asked to answer a follow-up questionnaire 90 to 120 days following dental intervention. Data collected from these questionnaires were used to evaluate the effects of dental intervention on horse general behaviour and appetite (Table 1).

The Chi-square test of independence was used for paired comparisons and the level of significance was set at 5% ($P \leq 0.05$).

RESULTS

According to dental chart data, 45 (60%) horses had incisor occlusal surface abnormalities and five (6.6%) had long incisors ($EMC > 15mm$). Mean EMC was 11.71mm (± 4.11), median of 11mm, minimal of 4.2mm and maximal of 22.4mm. Measurements taken after cheek teeth occlusal adjustment revealed another 14 (18.6%) horses with EMC distances exceeding 15mm.

When clinical examination and history data (thin and regular body condition scores, cheek teeth malocclusion, reported digestive problems and observed dysmastication) were considered, the need for reduction of incisor length was significant in cases where EMC exceeded 15mm ($P < 0.0001$).

The need for incisor shortening based on tooth shape (1-Excessively long incisors arcades from lack of occlusal contact and/or wear; 2-Smile bite, or dorsal curvature of incisor arcade; 3-Frown bite, or ventral curvature of incisor arcade; 4-Diagonal bite with or without an offset jaw and 5-Stepped or irregular incisor bite) was significant ($P < 0.05$).

Dental chart analysis revealed 22 (29.3%) horses with dysmastication and/or digestive problems, such as abnormal, slow or intermittent mastication, drop of food from the mouth or quidding and a history of weight loss or difficulty to gain weight, and colic during the 90 days previous to dental examination. The need for incisor shortening based on clinical history of dysmastication and/or digestive problems was significant ($P < 0.05$).

According to body condition scores documented at the time of dental intervention, eight (10.7%) of the 75 horses were thin, 29 (38.7%) were regular, 36 (48%) were in good condition and two (2.6%) were obese. The need for incisor shortening or alignment based on body condition score was also significant ($P < 0.05$). All thin horses required incisor alignment and/or shortening. The need for alignment and/or reduction of incisor length was significantly reduced in horses with regular or good body condition scores. Obese horses did not require incisor alignment and/or shortening.

Data collected from follow-up questionnaires revealed that 59 (78.3%) horses responded better to riding commands, 43 (56.5%) showed increased willingness to work, 36 (48.3%) showed improved appetite and 43 (56.5%) showed better behavior (decreased nervousness) in the 90 to 120 days following dental intervention. According to additional comments provided by the owners and riders, 48 (65.2%) horses had to be submitted to feeding restriction due to excessive weight gain.

DISCUSSION

Some authors define ideal occlusion as the one that brings the biomechanical forces acting on the incisors, cheek teeth and temporomandibular joint into balance. For that purpose, EMC distance should be equal to the width of a central incisor, or 10 to 20mm (EASLEY, 2011). But using width of a



Figure 1 - Horse under sedation with eighth years old. The Bussico gauge was inserted between the occlusal surfaces of the incisor teeth for assessment of incisor alignment.

central incisor as a guide for EMC can be misleading, because the teeth get narrow with age. A 4 year-old horse can have almost twice width of a central incisor when compared to another whit 20 year-old (SCRUTCHFIELD, 2006).

Determination of the cheek teeth interocclusal distance can be used to decide if incisor shortening is required. Using a light source, this distance can be estimated elevating the head and pulling the cheek away from the teeth in a sedated horse (DIXON et al., 1999). However, elevation of the head causes a six to eight mm rostrocaudal movement of the mandible that may influence the normal contact relationship between molars and premolars (EASLEY, 2011; TOIT & RUCKER, 2011).

RUCKER (2004) measured the EMC in 730 horses aged between one and 27 year-old. According to the author, the decision to reduce the length of incisor should not be arbitrary or based on EMC distance alone and might be influenced by other factors such as body condition score, chewing ability,

fecal fiber length and residual molar reserve crown. However, these additional factors were not evaluated in that study. In this retrospective study the objective was to evaluate the relationship between occlusal and clinical parameters and the need for incisor shortening in horses.

The decision to reduce the incisor length based solely on EMC distance may be misleading due to the variation in incisor teeth size and width with age (TOIT & RUCKER, 2011). In this study, clinical and occlusal parameters were also considered. This can provide a safer and more solid indication for the procedure.

How the horses of different breeds, housed at different locations and submitted to different training conditions were used, feeding regime was not the same for all patients. Fecal fiber length could not be analysed because some horse owners did not allow collection of rectal fecal samples at the time of dental examination or thereafter.

Conflicting opinions on the incidence of incisor malocclusion in horses are found in

Table 1 - Follow-up questionnaire. Horse owners and riders were asked 90 to 120 days following dental intervention.

-----DENTAL EXAMINATION – FOLLOW-UP*-----			
Name of the horse:			
Signalment:			
Please provide information regarding changes observed following dental intervention			
A	Riding	() improvement	() no improvement
B	Willingness to work	() improvement	() no improvement
C	Appetite	() improvement	() no improvement
D	Behavior	() improvement	() no improvement
Other observations & comments:			

* Follow-up period is between 90 and 120 days post dental intervention.

literature (DIXON et al. , 1999; RUCKER, 2006; SCRUTCHFIELD, 2006; DELOREY, 2008; EASLEY, 2011). While some consider mild abnormalities irrelevant, others see the same findings as important for occlusion exam and its influence in chew. In this retrospective study only horses that had been in confinement for over one year were used. The use of a Bussico gauge to assess incisor alignment in all cases enabled identification of mild incisor misalignments. This explains the high incidence of abnormalities (60%) documented in the horses studied. It should be noted that information regarding the animal housing system (pasture or confinement) is not always presented, rendering comparison of the results difficult.

The fact that another 14 (18.6%) horses had EMC distances exceeding 15mm following floating and cheek teeth wear abnormalities corrected indicates that the amount of occlusal adjustment and odontoplasty can affect the excursion to molar contact. According to TOIT & RUCKER (2011) occlusal incisors malocclusions are often secondary to disorders of cheek teeth and result in abnormal masticatory action. The amount of occlusal adjustment and odontoplasty is a subjective procedure that will affect the excursion to molar contact.

The greater need for incisor shortening in horses with thin or regular body condition scores that had a history of digestive problems and presented with dysmastication, EMC exceeding 15mm and cheek teeth malocclusion suggests that incisor length affects cheek teeth occlusion (SCRUTCHFIELD, 2006; EASLEY, 2011). Data related to the influence of dental problems on feed digestibility have been published (SCHUMACHER & MAIR, 1986; DIXON & DACRE, 2005; PAGLIOSA, 2006; SCRUTCHFIELD, 2006; EASLEY, 2011) and justify the need to restrict feeding due to excessive weight gain following dental intervention reported by owners in 48 (65.2%) horses in this study. According

to TAMZALI (2006) as regards the types of disease diagnosed, virtually all possible causes of weight loss were represented, with a high prevalence of dental (20%) disorders. Chronic weight loss is a syndrome frequently encountered in equine practice. However, since many different diseases can result in weight loss, this is often a frustrating condition for the clinician. Dental disorders, including incisors malocclusions, must be investigated during the exam to diagnose the cause of chronic weight loss.

According to EASLEY (2011), the need for dental intervention is usually not obvious to horse owners, trainers and riders until the disease has progressed to a more serious state. This is because clinical signs related to dental conditions are non-specific and may reflect diseases in different organ systems. Maybe, some data there are not recorded in dental charts because the clinic signals were not evident, so the changes were perceived after the occlusal adjustment.

Better response to riding commands and increased willingness to work (78.3% and 56.5% of the patients respectively) reported by the riders may reflect the positive effects of judicious occlusal adjustment achieving ideal functional occlusion. Painful processes affecting the buccal mucosa and tongue and premature dental contact (waves and steps) may translate into defensive postures and possibly spasms and contracture of facial and neck muscles.

CONCLUSION

Based on previously published reports and the results of the current retrospective study, it was concluded that the decision concerning the need for incisor shortening in confined horses should be based on history and clinical findings of dysmastication and digestive problems, body condition score, incisor teeth format and EMC distance. The need for incisor

reduction and alignment should be determined before dental intervention and reassessed right after cheek teeth occlusal adjustment.

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Bussico gauge, World Wide Equine Inc., Glenns Ferry, ID 83623, USA.

* Follow-up period is between 90 and 120 days post dental intervention.

REFERENCES

CARMALT, J.L. et al. Effect of dental floating on weight gain, body condition score, feed digestibility and fecal particle size in pregnant mares. **Journal of American Veterinary Medical Association**, v.12, p.1889-1893, 2004.

DELOREY, M.S.A. Retrospective evaluation of 204 diagonal incisor malocclusion corrections in horse. **Journal Veterinary Dentistry**, v.24, p.145-149, 2008.

DIXON, P.M.; DACRE, I. A review of equine dental disorders. **Veterinary Journal**, v.169, p.165-187, 2005.

DIXON, P.M. et al. Equine dental disease. Part 1: a long-term study of 400 cases: disorders of incisors, canine and first premolar teeth. **Equine Veterinary Journal**, v.5, p.369-377, 1999.

EASLEY, K.J. Corrective dental procedures. In: EASLEY, K.J. et al. (Eds.). **Equine dentistry**. 3.ed. London: Saunders, 2011. p.261-277.

KILIC, S. et al. A light microscope and ultrastructural examination of calcified dental tissues of horses: 1.The occlusal surface and enamel thickness. **Equine Veterinary Journal**, v.3, p.190-197, 1997.

PAGLIOSA, G.M. **Influência das pontas excessivas de esmalte dentário na digestibilidade dos nutrientes das dietas dos equinos**. 2004. 34f. Dissertação (Mestrado em Clínica e Cirurgia) – Curso de Pós Graduação em Medicina Veterinária, Escola de Veterinária, Universidade Federal de Minas Gerais, Minas Gerais, MG.

RUCKER, B.A. Incisor and molar occlusion: normal ranges and indications for incisor reduction. American Association of Equine Practitioners, 50., Denver, CO, EUA. **Proceedings...** Denver: AAEP, 2004, p.7-12. Accessed: 11 abr. 2008. Online. Available from: <<http://www.ivis.org/proceedings/AAEP/2004/Rucker1/chapter.asp?LA=1>>.

SCRUTCHFIELD, W.L. Expanding equine dental practice and dental examination. North American Veterinary Conference, .20, Orlando, FL, EUA. **Proceedings...** Orlando: NAVC, 2006, p.218-219. Accessed: 19 abr. 2008. Available from: <<http://www.ivis.org/proceedings/navc/2006/LA/086.asp?LA=1>>.

SCHUMACHER, J.; MAIR, T.S. Small colon obstructions in the mature horse. **Equine Veterinary Journal**, v.4, p.261-263, 1986.

TAMZALI, Y. Chronic weight loss syndrome in the horse: a 60 case retrospective study. **Equine Veterinary Education**, v.18, p.289-296, 2006.

TOIT, N.; RUCKER, B.A. Geriatric dentistry. In: EASLEY, K.J. et al. (Eds.). **Equine dentistry**. 3.ed. London: Saunders, 2011. p.279-287.