Abstract: Throughout equitation history, bitted bridles have been the primary method of controlling the ridden horse. In response to health and behavioral concerns arising from the use of bitted bridles, bitless bridles offer new methods of steering and control. However, the effectiveness of bitless bridles on horses had not been previously examined scientifically. Therefore, the current study measured behavioral and cardiac responses of horses undergoing foundation training (bridling, long-reining and riding) wearing either a bitted or bitless bridle. The horses wearing the bitted bridle exhibited more chewing, opening of the mouth, pawing the ground and tail swishing than those in the bitless bridle. The horses wearing the bitless bridle exhibited more head lowering during long-reining compared to those in the bitted bridle. The frequency of chewing, opening the mouth and head raising decreased as training progressed. The number of steps taken after the application of the halt stimulus was greatest for the horses in the bitted bridle during long-reining compared with those in the bitless bridle. During long-reining, the heart rate and heart rate variability of the horses were higher for those in a bitted bridle compared with a bitless bridle. The results of this study suggest that horses wearing bitless bridles performed at least as well as, if not better than, those in bitted bridles. If the use of bitted bridles does cause discomfort to horses as suggested by some, then the use of bitless bridles could be beneficial and certainly warrants further investigation.

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Preliminary investigations of horses' (*Equus caballus*) responses to different bridles during foundation training

Running title: Responses of young horses to different bridles

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Abstract

Throughout equitation history, bitted bridles have been the primary method of controlling the ridden horse. In response to health and behavioral concerns arising from the use of bitted bridles, bitless bridles offer new methods of steering and control. However, the effectiveness of bitless bridles on horses had not been previously examined scientifically. Therefore, the current study measured behavioral and cardiac responses of horses undergoing foundation training (bridling, long-reining and riding) wearing either a bitted or bitless bridle. The horses wearing the bitted bridle exhibited more chewing, opening of the mouth, pawing the ground and tail swishing than those in the bitless bridle. The horses wearing the bitless bridle exhibited more head lowering during long-reining compared to those in the bitted bridle. The frequency of chewing, opening the mouth and head raising decreased as training progressed. The number of steps taken after the application of the halt stimulus was greatest for the horses in the bitted bridle during long-reining compared with those in the bitless bridle. During long-reining, the heart rate and heart rate variability of the horses were higher for those in a bitted bridle compared with a bitless bridle. The results of this study suggest that horses wearing bitless bridles performed at least as well as, if not better than, those in bitted bridles. If the use of bitted bridles does cause discomfort to horses as suggested by some, then the use of bitless bridles could be beneficial and certainly warrants further investigation.

Keywords

Behavior, bit, bitless, bridle, heart rate, horse, training.
**Introduction**

From the time when horses were first tamed as a source of milk and meat 5,000 years ago (Waran et al., 2002), to modern day when horses have become companions used for pleasure and sport, a variety of methods designed to control the horse have existed. One such device is the bit, introduced in 2300 BC with the original design consisting of a straight bar mouthpiece carved from hardwood (Edwards, 2000) and now more commonly made of metal (Britton, 1995).

Bits are fitted within the mouth (Vernon, 1998) and depending on the design of the bit are intended to apply pressure to a number of different points on the horse's head including the lips, diastema, hard palate, summit of nuchal crest, lower mandible and tongue (Waran et al., 2002). As safety is of paramount importance in the equine industry (Macbeth, 2003), humans desire the comfort of knowing that the horse can be controlled when riding and driving. However, bits are a potential source of enormous discomfort to the horse as the mouth is a highly sensitive site (McLean and McGreevy, 2005).

Despite the universal use and acceptance of bitted bridles by riders, a substantial number of problems caused by the bit are now hypothesized. These problems are said to range from mild to acute conflict behaviors such as bucking, rearing and bolting, as well as training concerns such as a lack of flexibility, energy or forward motion, and leaning on, or being above, the bit (Cook and Strasser, 2003). Expressions of horses'
attempts to take flight from a situation that is causing them stress, known as hyper-reactive responses, have been recognized in horse behavior (McLean, 2003). For example, the extension of the neck by raising the head is seen as a hyper-reactive response to bit pressure (McLean and McGreevy, 2005).

Consequently, there are new concepts of horse control emerging that focus on bitless methods. One such design is a bitless bridle which is based on a method of steering and control not previously utilized in any other bitted or bitless bridle. Cook's (1999) design is meant to be a 'pain-free' rein aid, based on pressure mainly across the nasal plane, less along the cheeks and least across the nuchal crest. The pressures employed with this bitless bridle are spread over a larger surface area than with a traditional bitted bridle and are essentially used to effectively and gently 'push' the horse in the desired direction. A bitted bridle on the other hand, would tend to focus greater pressure on the smaller and highly sensitive region of the horse's mouth (Cook, 1999).

The bitless bridle should not be confused with existing bitless bridles such as the hackamore or bosal, as the construction and function of the styles differ greatly. For instance, when used correctly, the hackamore provides communication using anterior pressure, which is effective to restrain forward movement, halt and encourage the horse to lower its head (Britton, 1995). However, lateral communication for turning and steering is limited in hackamore and bosal bridles (Cook and Strasser, 2003) without supplemental training to teach the horse to respond to an indirect or neck rein. It is often thought that since such pre-existing bitless bridles do not incorporate a bit in their
design, they are not capable of inflicting pain to the horse. However, they still hold the potential to cause injury if used by a rider with unyielding hands. This is of particular importance when combined with the leverage offered by devices with longer curb shanks, as the pressure applied by the rider that is already concentrated over relatively small areas of the nose and poll is magnified (Britton, 1995). In conjunction with the potentially painful materials used to construct some bitless bridles, such as chain in the noseband, it can take very little physical effort on the part of the rider to injure a horse’s nose or jaw.

In training and behavioral studies, cardiac measures such as heart rate and heart rate variability have been regarded as measures of stress in horses (Mohr et al., 2000; Visser et al., 2002). Likewise, certain behavioral responses such as ear movements (Heffner and Heffner, 1983; Wolski, 1984), head position (Feist and McCullough, 1976; Kesel and Neil, 1998; Waring, 2003), licking of the lips and chewing (Parelli, 1993; Roberts, 1996), pawing the ground and sniffing the ground (McDonnell and Poulin, 2002), have also been regarded as measures of the arousal state of horses.

Accordingly, the following study examined the cardiac and behavioral responses of horses whilst undergoing foundation training wearing either a bitless bridle or a bitted bridle.

**Materials and methods**

**Horses**
Six horses (aged 2 years) of thoroughbred (n=2), warmblood (n=2) or Australian Stock Horse (n=2) breeding that had previously only had basic training with a head collar and lead rope (i.e. had not previously had a bridle or saddle on, or been mounted) were originally recruited into the program. Three of the horses were geldings and three were fillies. None of the fillies were observed to be showing signs of estrus during the study. Unfortunately, due to circumstances beyond the control of the experimenters (one horse was injured and one student withdrew from the program), only 4 horses completed. The horses were housed in yards (9 m x 6 m) that included rubber-lined shelters with a pine shavings bed at the Orange Campus Equine Centre of Charles Sturt University. The horses were maintained on hay (Lucerne and oaten) and supplemented with a concentrate feed (CopRice Cool Conditioner, CopRice, PO Box 561, Leeton, NSW, 2705, Australia) to meet National Research Council (1989) equine nutritional guidelines.

**Procedure**

Both bridles were full sized. The bit used in the bitted bridle was a standard full-sized Fulmer (FM) snaffle. The bitless bridle used was the BitlessBridle™ (BitlessBridle Inc. 1200 Nursery Road, Wrightsville, PA, 17368 USA) which makes use of an under the chin cross-over strap (Figure 1). The horses were paired for breed and sex such that half the horses wore a bitted bridle and the other half a bitless bridle (Table 1). Prior to the commencement of the trial, all horses were familiarized with wearing a firmly secured lungeing roller. They were initially introduced to the test arena during the first two days of foundation training and free-lunged at walk and trot until they appeared to
be in a calm state. This was assessed by observation of the horses not showing any behavioral signs of tension such as alertness, raised head carriage (Feist and McCullough, 1976; Kesel and Neil, 1998; Waring, 2003) and increased frequency of ear movements (Heffner and Heffner, 1983; Wolski, 1984).

On the test days, each horse was caught, had a webbing head collar and cotton lead rein applied and led into the centre of the test arena. Lunging rollers secured the heart rate monitor (Polar Accurex II, Baumann and Haldi, Switzerland) such that the lubricated electrodes were placed under the roller, 15 cm below the wither on the right side and behind the elbow on the left side. At the commencement of each session, each horse was held still while a pre-test heart rate was recorded for 60 s. The day-to-day procedure for the foundation training was then followed as described in Table 2. The sequence of testing of pairs alternated but the same experienced handlers who were familiar to the horses were used throughout testing. The procedures used in these trials were normal handling procedures and the experimental protocol was approved under Protocol Number 06/120 (Animal Care and Ethics Committee, Charles Sturt University, Australia).

1. Bridling

The heart rate monitor application was completed as described above. Each horse was fitted with a bridle according to which group they were allocated (Table 1). The procedure for putting on the bridle was as follows. Beginning with the horse wearing a halter and lead rope, the handler would stand on the left side of the horse, at the neck,
facing the front of the horse. Then with the right hand passing around the front of the horse's nose holding the bridle, the left hand then guided either the bit into the horse's mouth for the bitted bridle or the crossover straps under the chin for the bitless bridle. Once the bit or crossover straps were in place, the bridle was placed over the ears to be positioned on the summit of the nuchal crest. The throatlatch of the bitted bridle was secured and fitted, allowing for approximately 5 cm between the throatlatch and the throat (Edwards and Thomas, 1998). The buckle on the chinstrap of the bitless bridle was tightened so that one flat finger was able to fit between the chinstrap and the ventral aspect of the mandible. Once the bridle was securely in place, the horse was held still beside the handler for 5 min. The bridle was then removed by undoing the throatlatch and noseband or chinstrap, then sliding the headpiece forward over the horse's ears and allowing the bridle to fall gently off the head. The horse was then held still beside the handler for a further 60 s to determine the horse's response after the bridle was removed.

2. Long-reining

The heart rate monitor application and bridling procedure were completed as described above. Once bridled according to their allocated group, cotton lunge reins were attached to the bit rings on the bitted bridle or to the rings of the crossover straps on the bitless bridle. The inside rein passed through the D-ring on the same side of the lunge roller and then to the trainer's hand while the outside rein passed through the D-ring on the outside of the lunge roller, around the horse's hindquarters and then to the trainer's hand. From the centre of the arena the handler guided the horse around the test arena
using verbal commands and pressure on one or both of the long-reins for a period of 10 min.

3. Riding

The bridling procedures were completed as described above. Then, a standard thick cotton saddlecloth and an Australian stock saddle were fitted to each horse and the long-reining procedure conducted as previously described. When long-reining with the horse saddled, the lunge reins were placed through the corresponding stirrup irons rather than the D-rings of the lunge roller. The stirrup irons were tied in the ‘down’ position in place under the horse’s girth to reduce free swinging. The heart rate monitor electrodes were securely placed underneath the girth behind the elbow on the left side, and underneath the saddlecloth 15 cm below the wither on the right side. The girth and surcingle were then secured firmly. For safety reasons, given that this was the first time the horses had been mounted, an additional handler (who was familiar to the horses) assisted the rider from the ground. As the handler held the horse from the near side, the rider mounted the horse from the same side. The handler then left the test arena and the rider proceeded to work the horse in various gaits (walk, trot and canter) for a total period of 10 min.

Measurements and data analysis

All behavioral responses exhibited by the horses were recorded using a Swann Security Video Camera (Swann Communications Pty. Ltd. Building 4, 650 Church Street, Richmond, Victoria, 3121, Australia) for subsequent analysis on a continuous
observation basis. The behavioral responses observed and quantified included chewing, mouth opening, ear movements, pawing the ground, swishing the tail, head shaking, snorting, yawning, bucking and defecating, and were defined according to Waring (2003). Cranial movements including head lowering, raising or shaking/tossing. Other responses recorded were sniffing the ground, rubbing the muzzle on the ground or themselves, lifting and stamping a leg and taking steps. In addition, the number of steps taken after the application of the halt stimulus was also noted. The frequency of each response was counted for each minute and then the means for the testing time used in the analysis. Heart rates were recorded continuously at 5 s intervals during testing and the data were later downloaded using the Polar Equine Software (Version 4.0, Polar Electro Europe BV, Fleurier Branch, Switzerland). Heart rate variability was determined by the number of changes of heart rate during the test period.

The number of horses that completed the trial prevented any reliable statistical analyses, therefore only a descriptive analysis of the data is included. This was performed using Microsoft Excel (2007).

**Results**

The horses wearing the bitted bridle exhibited more chewing and opening of the mouth than those wearing the bitless bridle throughout all stages of training and the frequency of these responses decreased as training progressed (Figures 2 and 3). The horses wearing the bitless bridle exhibited more head lowering during long-reining than those wearing the bitless bridle (Figure 4). All horses, regardless of bridle, showed head
raising during training, although the frequency of head raising was least during bridling (Table 3). The horses wearing the bitted bridle did more head shaking during bridling and long-reining than those wearing the bitless bridle (Table 3). During riding, it was the horses wearing the bitless bridle that seemed to be doing more head shaking than those wearing the bitted bridle (Table 3). Pawing the ground occurred most during the bridling phase of training bridling by the horses in the bitted bridle (Table 3). The horses wearing the bitted bridle exhibited most tail swishing throughout training compared to those in the bitless bridle (Table 3). The number of steps taken after the application of the halt stimulus (measured during long-reining and riding only) was greatest for the horses in the bitted bridle during long-reining compared with those in the bitless bridle (Figure 5). During long-reining, the heart rate and heart rate variability of the horses were higher for those in a bitted bridle compared with those wearing a bitless bridle (Figure 6).

**Discussion**

The horses wearing the bitted bridle exhibited more chewing and opening of the mouth during testing, an outcome that can most likely be attributed to the fact that they had a foreign object, i.e. a bit, in their mouth. According to the international body governing equestrian sports (Fédération Equestre Internationale, 2005), 'satisfactory activity' of the mouth is permitted, although it should be noted that what exactly is meant by 'satisfactory activity' was not explained. Nonetheless, opening the mouth is anecdotally considered to be an undesirable response in a performance horse, so for this reason the use of a bitless bridle would be preferred. Conversely, chewing has been regarded as an
indicator of a horse being 'relaxed in the bridle' (Podhajsky, 1967; Anon, 1990) and therefore a bitted bridle would be preferred to encourage this response. Evidently clarification is required to determine the difference between 'satisfactory activity of the mouth' and 'chewing the bit', especially as in some equestrian disciplines, one is acceptable and one is not. In the light of recent research (de Cartier et al., 2005; Warren-Smith and McGreevy 2007; Warren-Smith et al., 2007), it seems that it would be appropriate to revise the standards and criteria for judging of equestrian disciplines with a particular view to including objective measures.

Head lowering has been reported to improve horses’ performance in visual discrimination trials (Hall et al., 2003), as one of the behavioral responses of horses undergoing massage (McBride et al., 2004) and has been associated with behavioral states such as resting (Caanitz et al., 1991), relaxation (Chamove et al., 2002) and freedom to stretch (Blignault, 1997). Head lowering was shown more by the horses who wore the bitless bridle during long-reining. From the current study, it is difficult to determine if the head-lowering performed by the horses was due to relaxation or stretching. Regardless, both states represent a favorable outcome in horse undergoing foundation training.

A desirable characteristic of competition horses is a steady head carriage whilst performing (Marshall, 1981; Anon, 1986; Anon, 1988; Fédération Equestre Internationale, 2005). Movements such as shaking or raising of the head have been reported as responses to discomfort or pain (MacDonald, 2003) in locations of the body
such as the mouth, limbs and back (Fraser, 1992). Head movements (shaking/tossing) were exhibited mostly by the horses that wore the bitted bridle during the bridling days and by those wearing the bitless bridle on the riding days. This suggests that these horses were showing the most discomfort during these training sessions. It is encouraging that there was a decrease in the frequency of head shaking/tossing as training progressed, indicating that the horses were becoming accustomed to the bridles and the training.

A number of researchers have noted that pawing the ground is a behavioral response exhibited during a conflict situation (Ödberg, 1973; Luescher et al., 1991; Redbo et al., 1998), examples being either as an activity of distraction, or in anticipation of the release from restraint or a stationary position. Pawing the ground was mostly exhibited during the bridling sessions by the horses in both groups. This outcome is most likely explained by the fact that it was during this stage of training that all horses first experienced having the bridles put on, thus some conflict could be expected. Given that the frequency of pawing was greatly decreased during the rest of the training sessions, it would appear that the horses became accustomed to the bridling process relatively quickly i.e. after the initial bridling session.

One of the aims of long-reining is to introduce horses to the rein stimuli that they will encounter during other activities, such as when ridden (Kusunose and Yamanobe, 2002). Consequently it is during long-reining that horses usually first encounter the various stimuli that are applied to the reins for steering, slowing and stopping. During
long-reining, the horses wearing the bitted bridle took more steps after the application of the halt stimulus before achieving the halt than those in the bitless bridle. This indicates that the horses in the bitless bridle were more likely than those in the bitted bridle to be able to perform the correct response to the halt stimulus when learning this stimulus-response relationship. In addition, the horses wearing the bitless bridle had the lowest heart rates and heart rate variability during long-reining, implying that the horses wearing the bitted bridle were in the most pain when first encountering rein stimuli. Given that the rein tensions required to elicit the same responses are greater for long-reining than riding (Warren-Smith et al., 2007), this outcome seems logical and handlers should take care when long-reining to try to use the lightest possible stimuli to preserve the sensitivity of horses’ mouths.

It has been suggested that the use of a foreign metal object in an area as sensitive as the oral cavity causes pain to the horse, whether or not the rider or handler is aware of its infliction (Cook, 1999). That the horse's heart rates were not different during bridling is of significance as it was the horses' first experience of bridling and no locomotion was involved which could have influenced the heart rate of the horses. Cook and Strasser (2003) indicated that the use of a bit in a horse's mouth can also lead to other problems such as on the respiratory system, where the interference caused by a bit can impede breathing and striding, leading to a decrease in the amount of exercise that a horse can perform, as well as the overall quality of the horse's movement. Pain has been found to contribute to an increased heart rate in horses (Rietmann et al., 2004) and heart rate and heart rate variability have been used as an indicator of stress in horses (Mohr et al.,
Given that the horses wearing the bitted bridle had the highest heart and heart rate variability during long-reining, we could conclude that these horses were in more pain and experiencing higher stress levels than those wearing the bitless bridle during foundation training.

It should be noted that any conclusions drawn from these results should be done so with caution as the low numbers of horses used will have influenced the outcomes. The small sample size not only prohibited reliable statistical analyses to be conducted, but would also have prevented subtle differences from being statistically detected (Berndtson, 1991; Simpson, 2002). In addition, when dealing with untrained horses in an applied setting, insisting that each horse does exactly the same exercise is not always possible, especially when safety of students must also be ensured. Whilst every effort was made to standardize all activities, the results for both heart rate and heart rate variability could be attributed to inconsistencies in the amount of locomotion each horse was performing, especially during the long-reining and riding sessions.

While the results of this study have revealed some interesting outcomes that should stimulate some consideration of the equipment and methods employed with horses, there are also some challenges that need to be overcome when conducting further work in this area. Firstly, working with horses is considered to be a high risk activity and this was particularly important in the current study as the horses that were used had previously only had minimal handling i.e. haltered. Secondly, the study was integrated into the teaching of an undergraduate program and as such, student safety and learning
were paramount. Thirdly, the aim of the study was to conduct the trial in an environment that accurately reflected standard practice of the horse industry, rather than in a closed environment of a treadmill laboratory for example. Conducting research in applied settings can make it difficult to control every variable. Fourthly, the resources required to maintain large numbers of horses for research purposes makes it prohibitive to do so. Collectively, the above mentioned points contributed to the current study having a low number of horses, different handlers for some parts, and that the exact exercise that each horse did on each test day may not have been precisely the same every time.

When conducting research with horses, especially when testing is being carried out in the field as opposed to a laboratory, depending on the type of study being conducted, it is important that the methodology accurately reflects what occurs as standard practice in the horse industry. This then enables the results to be more relevant to a greater proportion of the horse industry. Furthermore, it should make the application of the findings more readily acceptable to participants in the horse industry as they can be seen as being more practical than results obtained in environmentally controlled laboratories.

However, these problems do not necessarily mean that the research should not be conducted. Preliminary investigations set an important baseline for further work. For instance, subsequent trials of a similar focus should be conducted using additional measurements such as a rein tension meter to quantify any variability in the amount of
tension applied to the reins (Warren-Smith et al., 2007), as well as greater numbers of horses.

Conclusions

Horses wearing the bitted bridle exhibited more chewing, opening of the mouth, pawing the ground and tail swishing than those in the bitless bridle. The horses wearing the bitless bridle exhibited more head lowering during long-reining compared to those in the bitted bridle. The frequency of chewing, opening the mouth and head raising decreased as training progressed. The number of steps taken after the application of the halt stimulus was greatest for the horses in the bitted bridle during long-reining compared with those in the bitless bridle. During long-reining, the heart rate and heart rate variability were higher for those in a bitted bridle compared with a bitless bridle. If the use of bitted bridles does cause discomfort to horses as suggested by some, then the use of bitless bridles could be beneficial and certainly warrants further investigation. In the interests of welfare of horses in training, there is a need to conduct further work in this area, using larger numbers of horses, to determine conclusively the benefits of using bitless bridles in preference to bitted bridles.

Acknowledgements

The authors would like to thank Stephen Mannix, Caroline Moon, Shana Wilkinson, Bartlomiej Bronicki, Amelia Brydon, Felicity Casey and Teena Hough for their assistance in this trial.
References


List of Tables

Table 1. The characteristics of the horses and the bridle group to which they were allocated.

<table>
<thead>
<tr>
<th>Horse</th>
<th>Age (yrs)</th>
<th>Breed</th>
<th>Sex</th>
<th>Bridle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Warmblood</td>
<td>Gelding</td>
<td>Bitted</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Warmblood</td>
<td>Filly</td>
<td>Bitless</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Thoroughbred</td>
<td>Gelding</td>
<td>Bitless</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Australian Stock Horse</td>
<td>Filly</td>
<td>Bitted</td>
</tr>
</tbody>
</table>

Table 2. The day-to-day procedure for the foundation training that was followed.

<table>
<thead>
<tr>
<th>Day</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All horses were introduced to test arena.</td>
</tr>
<tr>
<td>2</td>
<td>All horses were introduced to test arena.</td>
</tr>
<tr>
<td>3</td>
<td>All horses were bridled for the first time in test arena.</td>
</tr>
<tr>
<td>4</td>
<td>All horses were bridled for the second time in test arena.</td>
</tr>
<tr>
<td>5</td>
<td>All horses were bridled for the third time in test arena.</td>
</tr>
<tr>
<td>6</td>
<td>All horses were long-reined for the first time in test arena.</td>
</tr>
<tr>
<td>7</td>
<td>All horses were long-reined for the second time in test arena.</td>
</tr>
<tr>
<td>8</td>
<td>All horses were long-reined for the third time in test arena.</td>
</tr>
<tr>
<td>9</td>
<td>All horses were ridden for the first time in test arena.</td>
</tr>
<tr>
<td>10</td>
<td>All horses were ridden for the second time in test arena.</td>
</tr>
<tr>
<td>11</td>
<td>All horses were ridden for the third time in test arena.</td>
</tr>
</tbody>
</table>
Table 3. The mean of responses exhibited by horses during foundation training (bridling, long-reining and riding) wearing either a bitted or bitless bridle.

<table>
<thead>
<tr>
<th></th>
<th>Bridling</th>
<th></th>
<th></th>
<th>Long-reining</th>
<th></th>
<th></th>
<th>Riding</th>
<th></th>
<th>Average</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bitted</td>
<td>Bitless</td>
<td>Bitted</td>
<td>Bitless</td>
<td>Bitted</td>
<td>Bitless</td>
<td>Bitted</td>
<td>Bitless</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buck</td>
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<td>0.02</td>
<td>0.00</td>
<td>0.02</td>
<td>0.01</td>
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<tr>
<td>Chew</td>
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<td>0.17</td>
<td>0.00</td>
<td>0.00</td>
<td>0.76</td>
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<tr>
<td>Defecate</td>
<td>0.00</td>
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<td>0.08</td>
<td>0.05</td>
<td>0.03</td>
<td>0.06</td>
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<tr>
<td>Ear movement</td>
<td>12.88</td>
<td>10.47</td>
<td>10.92</td>
<td>9.43</td>
<td>12.13</td>
<td>10.58</td>
<td>2.07</td>
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<td></td>
</tr>
<tr>
<td>Head lower</td>
<td>1.07</td>
<td>0.55</td>
<td>1.00</td>
<td>2.02</td>
<td>0.30</td>
<td>0.02</td>
<td>0.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head lower</td>
<td>0.67</td>
<td>0.82</td>
<td>0.57</td>
<td>0.69</td>
<td>0.22</td>
<td>0.23</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head lower</td>
<td>2.23</td>
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List of Figures

Figure 1. The bitless bridle on one of the horses used in testing.
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