“Comparison of 2 Equine Surgical Tables”

DIPLOMARBEIT
zur Erlangung der Würde eines
Diplomtierarztes
der Veterinärmedizinischen Universität Wien

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**Comparison of 2 Equine Surgical Tables**

1. **Introduction**

Anaesthetic related mortality is higher in horses than in any other species (JONES 2001). Studies published between 1990 and 2001 estimate the rate of anaesthetic related equine fatalities to be approximately 1% (YOUNG and TAYLOR 1990, 1993; JOHNSTON 1991; JOHNSTON et al. 1995; RIJKENHUIZEN et al. 1998; MEE et al. 1998; JOHNSTON et al. 2002). This rate is substantially higher than the rate of anaesthetic deaths in companion animals (0.11%, DYSON et al. 1998) or human patients (0.008%, LAGASSE 2002). The necessity to stand postoperatively may increase the risk of anaesthesia in horses compared with small animals (TAYLOR 2002).

Post anaesthetic myopathy/neuropathy syndrome (PAMS) is the most common cause of perioperative morbidity in horses and can lead to subsequent euthanasia (VAN LOON et al 2010). The incidence of PAMS can be reduced by careful positioning and adequate padding (KLEIN 1990). Air mattresses, water beds or thick foam pads should be used during all but very brief procedures (KLEIN 1990; RIJKENHUIZEN et al. 1998). However in one study it was stated that even when using padding, proper limb positioning, and treatment for intra-operative hypotension the clinical incidence of PAMS appeared to have increased rather than decreased over the years since the purchase of the new equipment (DUKE et al. 2006).

During the last decade a steady development of surgery tables, their padding and their mattresses took place to minimize the risk of equine anaesthesia. There are a lot of surgery table models from many different companies on the market right now. Floor or wall based stationary models are still in use, but it is common to use mobile models with inbuilt hydraulic cylinders or a scissor based lifting mechanism (RIEBOLD et al. 1976; LOKAI et al. 1980; SCHATZMANN 1995).

The HAICO TELGTE II surgery table (Figure 1) is one of the most used tables in many clinics. Although the table has integrated cushioning, it is commonly used with extra padding. The newly developed EQUIVET surgery table (Figure 2), marketed and developed by KRUUSE, has a 10 cm integrated memory foam padding, which, according to the manufacturers, is claimed to be sufficient as padding for anaesthetized horses.

Other claimed improvements of the EQUIVET include: flexible side panels which can be placed exactly where they are needed along the side of the table. A hydraulic scissor based lifting and lowering system of the table that can be operated from each corner and allows lifting of a weight of up to 1000 kg. An inbuilt safety valve prevents the table from lowering faster when it is loaded. It has incorporated rubber feet to keep it in position on the floor. (Kruuse sheet: “SELLING POINTS 281600 EQUIVET Equine Surgery Table versus other tables” 2009)

The objective of this study was to compare the EQUIVET and the HAICO TELGTE II surgery table and their padding systems in its daily clinic use.
Figure 1: showing the HAICO TELGTE II surgical table (www.haico.fi)

Figure 2: showing the EQUIVET surgical table (Kruuse: EQUIVET selling sheet)
2. Materials and methods

**Surgical Tables:**
- HAICO TELGET II table. Two units are currently used at the author’s clinic; one was purchased in 2001; the other in 2003. Both were used in the study.
- EQUIVET table. This table was on loan to the hospital for evaluation and was subsequently purchased.

**Following points were studied to compare the two surgical tables**

A) Clinical Study

a. Satisfaction of the surgeons and anaesthetists, to test whether the improvements made to the EQUIVET table led to a more ergonomic “workbench” for surgeons and anaesthetists

b. Pedometric measurements of the surgeons and the assistants; this was based on the assumption that when a person achieves a comfortable posture while working there would be less movement

c. Postsurgical recovery score as a means to evaluate the incidence of PAMS

d. creatinkinase (CK) levels post anaesthesia to evaluate the efficiency of the padding to prevent PAMS

B) Technical studies to evaluate the safety and lifting capabilities of the tables

**A) Clinical study:**

The study was conducted between April and October 2009 at the Equine Hospital of the Veterinary University Vienna. There was no randomisation as far as table assignment was concerned. Seventy two surgeries in total were evaluated for surgeon and assistant comfort and ease of patient positioning using a (surgical table) protocol (see attachment) to be filled in by surgeon and anaesthetist. Pedometric measurements were included as method to measure objectively surgeon comfort. The recovery was evaluated studying the anaesthetists’ records and by serial CK testing. The surgeries were evaluated in the sequence in which they were conducted. Emergency surgeries were excluded from the study. Only surgeries, which led to completely filled in protocols, were included in the study.
**General Information**

- type of table (EQUIVET or HAICO) used
- signalment of the patients (age, sex, breed and weight)
- type of surgery (orthopaedic versus soft tissue)
- dorsal or lateral recumbency
- supports attached to the table used were marked on a template (Figure 3)

![Surgery Table Diagram](image)

*Figure 3: showing schematic drawing of the surgery table with all supports attached. In the protocol the evaluators were asked to tick off the supports used in the actual surgery. The coloured attachments are flexible.*

**Satisfaction**

After surgery specific questions were used to evaluate the satisfaction of the surgeons and anaesthetists regarding the tables.

User satisfaction was graded using the unspecific parameters of “good”, “moderate” or “bad”. If the user indicated that their satisfaction was either moderate or bad, they were asked to briefly describe the problem.
Questions asked of the surgeon regarding satisfaction with:

- positioning of the horses
- accessibility to the surgery field
- possibilities of adjusting the table
- ability to maintain a comfortable posture
- accessibility for the surgical assistant
- ease of draping the surgical field

Questions asked of the anaesthetist regarding satisfaction with:

- positioning of the horses
- fixation of the intubation system
- access for i.v. injections or infusions

**Pedometric Measurements**

It was hypothesised that surgeons who are uncomfortable in their standing position during surgery would move more than persons achieving comfortable access to the surgical field. A commercially available pedometer\(^1\) was used to determine the step count of the surgeon and surgical assistant during each surgery. The pedometers were zeroed and placed in the pockets of the surgeons’ and assistants’ scrub suits just before gowing. After surgery the step count was read and recorded in the protocol.

**Postsurgical period**

The anaesthetic protocol filled in by the anaesthetist was used to collect following data:

- anaesthetic time in minutes
- surgery time in minutes
- recovery time in minutes
- recovery score

\(^1\) Silva 56013-3
- quiet and safe (1)
- unsafe (2) (defined as more than 2 tries to stand up)
- wild (3) (defined as more than 4 tries to stand up)
- injured during the recovery period (4)
- post operative complications (related to anaesthesia).

**Creatinkinase (CK) measurement**

The enzyme activity of creatinkinase (CK) was determined on freshly collected Lithium Heparin venous blood samples. The samples were collected from the jugular vein catheter of each horse directly after the induction of anaesthesia (pre-anaesthetic, CK1), on completion of surgery (after the last skin suture, CK2) and 8 hours after successful attempt to stand (CK3). Samples were stored at 4°C until examination at the laboratory. The reference range for creatinkinase (CK) was defined with 200 units per litre (U/L). CK levels were determined on a Hitachi 911 using liquid chemistry according to manufacturer’s instructions at the Central Laboratory of the Veterinary University Vienna.

Protocols, in which a blood sample for the determination of the CK was missing, were excluded from the study. In horses in which the first CK sample exceeded 2x the reference value of 200 U/L (ie 400U/L) the CK values were excluded from the CK statistics. This was to avoid that CK values for pre-existing muscle damage were used to evaluate possible intra-operative muscle damage.

**B) Technical study**

In order to test the carrying capacity these tests were performed on both types of surgery tables unloaded and loaded with 600kg. The weight of a 600 kg horse was simulated by 24 sand bags, each weighing 25 kg, which were evenly positioned on the tables (Figure 4). The studies were performed in the actual surgical suite that both types of tables were used in. The floor consists of paint sealed concrete and was dry during the study.

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2 According to the reference table of the Central Laboratory of the Veterinary University Vienna
3 Roche Diagnostics, Vienna, Austria
4 Testkit Nr. 763 870, Roche Diagnostics, Vienna, Austria
The following data were recorded:

- lowering time from the highest to the lowest position measured in seconds
- raising time from the lowest to the highest position measured in seconds
- highest and lowest point that was reached with (top of the mattress) and without air mattress (surface of the table) measured in centimetres.
- maximum table blade angles related to the floor that were achieved by tilting the surgical tables into Trendelenburger and into Reverse Trendelenburger position, in degrees, using a compass.

- force (in Newton) that was needed to start moving both of the tables in a straight forward manner and at an angle of 45° (Figure 6) This was performed with the inbuilt braking mechanism of each table engaged or unengaged. These forces were measured with a digital spring balance\(^5\) that was fixed with a rope to the surgical tables. Traction to the rope was applied by one of the researchers. (Figure 5)

\(^5\) KERN HCB 200 K
• force that was needed to keep the table moving into the intended direction. This was performed with the inbuilt braking mechanism of each table engaged or unengaged using the above mentioned spring balance.

Resulting values were then multiplied with 9.81 to convert Force into Newtons (N) and rounded to Integers.

*Figure 5: showing one of the researches applying traction to a rope in an angle of 45°*
Figure 6: showing the directions (angles) in which the table was drawn

Statistical analysis

The differences in mean CK1, CK2 and CK3 were analyzed using t-tests for independent samples. Distribution of CK1, CK2 and CK3 values was shown by using box and whisker plots and scatter plots. To analyse the differences in the mean number of steps related to the table an analysis of covariances (ANCOVA) controlling for surgery time was performed. Correlations between surgery time and number of steps (Surgeon/Assistant) were calculated separately for each table using Pearson’s correlation. Level of significance was set to 5% (p < 0.05).

3. Results

Clinical study

Seventy two surgeries were recorded in our data base between April and October 2009. Sixty- one met the inclusion criteria. Unfortunately 6 cases had to be excluded due haemolysis in the blood samples that were used for the determination of the CK level. Fifty- five cases were finally included into the study; 35 surgeries were performed on the EQUIVET table and 20 on the HAICO TELGTE II. Nineteen orthopaedic and 36 soft tissue surgeries were performed (Table 1).
Nineteen mares, 22 stallions and 14 geldings were recorded. Horses with an age varying from 1 to 24 years and weighing from 160 to 710 kg were used in our study. At the EQUIVET the mean value for age and weight was calculated with 9 years and 456 kg.

At the HAICO TELGTE II the mean value for age and weight was calculated with 12 years and 497 kg.

<table>
<thead>
<tr>
<th>TOTAL</th>
<th>EQUIVET (35 surgeries)</th>
<th>HAICO TELGTE II (20 surgeries)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number</td>
<td>%</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stallion</td>
<td>18</td>
<td>51%</td>
</tr>
<tr>
<td>Mare</td>
<td>10</td>
<td>29%</td>
</tr>
<tr>
<td>Gelding</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>Positioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td>8</td>
<td>23%</td>
</tr>
<tr>
<td>Dorsal</td>
<td>27</td>
<td>77%</td>
</tr>
<tr>
<td>Breed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warmblood</td>
<td>22</td>
<td>63%</td>
</tr>
<tr>
<td>Thoroughbred</td>
<td>5</td>
<td>14%</td>
</tr>
<tr>
<td>Pony</td>
<td>8</td>
<td>23%</td>
</tr>
<tr>
<td>Kind of surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>soft tissue</td>
<td>29</td>
<td>83%</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>6</td>
<td>17%</td>
</tr>
<tr>
<td>Recovery score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (quiet and safe)</td>
<td>21</td>
<td>60%</td>
</tr>
<tr>
<td>2 (unsafe)</td>
<td>11</td>
<td>31%</td>
</tr>
<tr>
<td>3 (wild)</td>
<td>3</td>
<td>9%</td>
</tr>
</tbody>
</table>

Table 1: showing the percentage of sex, positioning, breed, kind of surgery and recovery score for both tables
Creatinkinase (CK) measurement

To calculate the mean, minimum and maximum values of the enzyme activity of CK1 (pre-anaesthetic), CK2 (after skin suture) and CK3 (8 hours after successful attempt of standing) for the EQUIVET and HAICO TELGTE II, were inserted into a statistical evaluation and displayed graphically (Fig. 3a and 3b).

The blood CK levels showed no significant differences for both tables at any timepoint.

<table>
<thead>
<tr>
<th></th>
<th>EQUIVET</th>
<th>HAICO TELGTE II</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>55</td>
<td>35</td>
</tr>
<tr>
<td>minimum value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CK1</td>
<td>85 U/L</td>
<td>85 U/L</td>
</tr>
<tr>
<td>CK2</td>
<td>86 U/L</td>
<td>87 U/L</td>
</tr>
<tr>
<td>CK3</td>
<td>209 U/L</td>
<td>178 U/L</td>
</tr>
<tr>
<td>maximum value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CK1</td>
<td>317 U/L</td>
<td>388 U/L</td>
</tr>
<tr>
<td>CK2</td>
<td>282 U/L</td>
<td>307 U/L</td>
</tr>
<tr>
<td>CK3</td>
<td>2815 U/L</td>
<td>2682 U/L</td>
</tr>
<tr>
<td>mean value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CK1</td>
<td>190 U/L</td>
<td>183 U/L</td>
</tr>
<tr>
<td>CK2</td>
<td>170 U/L</td>
<td>168 U/L</td>
</tr>
<tr>
<td>CK3</td>
<td>686 U/L</td>
<td>618 U/L</td>
</tr>
</tbody>
</table>

Table 2: showing the minimum, maximum and mean values for CK1, CK2 and CK3 for each table

A graphical representation was designed to show the statistical relations between the muscle enzyme activity of CK1, CK 2 and CK 3 plotted at both surgery tables.

A t-Tests was performed and revealed no significant difference between both tables in mean CK at any timepoint (CK1: p = 0.380; CK2: p = 0.431; CK3: p = 0.425).
Fig. 3a: Box and whisker plot showing the distribution of CK1 (pre-anaesthetic), CK2 (after skin suture) and CK3 (8 hours after successful attempt of standing) in U/L
Fig. 3b: Box and whisker plot showing the distribution of CK1 (pre-anaesthetic), CK2 (after skin suture) and CK3 (8 hours after successful attempt of standing) in U/L.

A graphical representation was designed to show the statistical relations between the muscle enzyme activity of CK 2 and CK 3 plotted in relation to anaesthetic time for both surgery tables.

No significant differences were observed between CK 2 and CK 3. The CK values in relation to the anaesthetic time were similar for the EQUIVET and HAICO TELGTE II table.
Fig. 4a: Scatter plot shows CK2 (after skin suture) in U/L

Fig. 4b: Scatter plot shows CK3 (8 hours after successful attempt of standing) in U/L
**Recovery Period**

**EQUIVET**

Out of 35 surgeries on the Equivet table 21 horses (60%) had a quiet and safe recovery (score 1). 11 (31%) were scored as unsafe (2) and 3 (9%) had a wild recovery (3).

Duration of recovery, from placing the patient into the recovery box to standing was 5 to 60 minutes. The mean value of the recovery time was 27 minutes.

For a recovery score of 1 (quiet and safe), 2 (unsafe) and 3 (wild) the mean values of the anaesthetical time were calculated with 67, 104 and 120 minutes (Fig. 5).

**HAICO TELGTE II**

Out of 20 surgeries on the Haico Telgte II table 13 horses (65%) had a quiet and safe recovery (score 1); 5 (25%) were scored as unsafe (2) and 2 (10%) had a wild recovery (3).

Duration of recovery, from placing the patient into the recovery box to standing was 15 to 55 minutes. The mean value of the recovery time was calculated with 31 minutes.

For a recovery score of 1 (quiet and safe), 2 (unsafe) and 3 (wild) the mean values of the anaesthetical time were calculated with 83, 108 and 127 minutes. (Fig. 5)

There were no significant differences in recovery score between both tables.
The results are described in Table 3. The only time that surgeons’ satisfaction was moderate or bad related to the EQUIVET surgical table was when a C-frame X-ray unit was used during surgery. The surgeons did however not specify the problem. The reasons for a moderate or bad satisfaction of the anaesthetists were related to the problem of keeping in place the horse’s head on the EQUIVET table. Four times anaesthetists mentioned that the fixation for the intubation system, which is integrated in the table, was too fragile.

The main reason for a moderate or bad satisfaction of the surgeons related to the HAICO TELGTE II table was a problem due to the braking mechanism of the wheels. In 3 cases the table was sliding away, when the surgeons were leaning against it. There were similar problems working with a C-frame X-ray unit on the HAICO TELGTE II. The problems with the C-frame appear associated with the sheer size of the unit and the resulting limitation of space in the surgical field. In 7 cases the reasons for a moderate or bad satisfaction of the anaesthetists were related to the positioning and fixation of the head.

Fig. 5: Box and whisker plot showing the distribution of the recovery score of 1 (quiet and safe), 2 (unsafe), 3 (wild)
Table 3: showing the percentage of satisfaction (surgeon/anaesthetist) for each table (*= significant difference (p<0.05))

<table>
<thead>
<tr>
<th></th>
<th>EQUIVET good</th>
<th>EQUIVET moderate</th>
<th>EQUIVET bad</th>
<th>HAICO good</th>
<th>HAICO moderate</th>
<th>HAICO bad</th>
<th>TELGTE II good</th>
<th>TELGTE II moderate</th>
<th>TELGTE II bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>positioning of the patient</td>
<td>94,3%</td>
<td>5,7%</td>
<td>-</td>
<td>80,0%</td>
<td>20,0%*</td>
<td>-</td>
<td>75,0%</td>
<td>25,0%*</td>
<td>-</td>
</tr>
<tr>
<td>accessibility to the surgery field</td>
<td>97,1%</td>
<td>-</td>
<td>2,9%</td>
<td>75,0%</td>
<td>25,0%*</td>
<td>-</td>
<td>95,0%</td>
<td>5,0%</td>
<td>-</td>
</tr>
<tr>
<td>adjustment of the table during the surgery</td>
<td>91,4%</td>
<td>8,6%</td>
<td>-</td>
<td>95,0%</td>
<td>5,0%</td>
<td>-</td>
<td>55,0%</td>
<td>45,0%*</td>
<td>-</td>
</tr>
<tr>
<td>ability to maintain comfortable posture</td>
<td>91,4%</td>
<td>5,7%</td>
<td>2,9%</td>
<td>55,0%</td>
<td>45,0%*</td>
<td>-</td>
<td>80,0%</td>
<td>20,0%*</td>
<td>-</td>
</tr>
<tr>
<td>accessibility for the surgical assistant</td>
<td>88,6%</td>
<td>11,4%</td>
<td>-</td>
<td>75,0%</td>
<td>25,0%</td>
<td>-</td>
<td>75,0%</td>
<td>25,0%</td>
<td>-</td>
</tr>
<tr>
<td>coverage of the surgery field</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>95,0%</td>
<td>5,0%</td>
<td>-</td>
<td>75,0%</td>
<td>25,0%*</td>
<td>-</td>
</tr>
</tbody>
</table>

Satisfaction of the anaesthetists:

<table>
<thead>
<tr>
<th></th>
<th>EQUIVET good</th>
<th>EQUIVET moderate</th>
<th>EQUIVET bad</th>
<th>HAICO good</th>
<th>HAICO moderate</th>
<th>HAICO bad</th>
<th>TELGTE II good</th>
<th>TELGTE II moderate</th>
<th>TELGTE II bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>positioning of the horses regarding anaesthesia</td>
<td>85,7%</td>
<td>14,3%</td>
<td>-</td>
<td>75%</td>
<td>15%</td>
<td>10%</td>
<td>75%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>fixation of the intubation system</td>
<td>74,3%</td>
<td>20,0%</td>
<td>5,7%</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
<td>75%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>accessibility to do i.v. injections or infusions</td>
<td>82,9%</td>
<td>17,1%</td>
<td>-</td>
<td>90%</td>
<td>10%</td>
<td>-</td>
<td>75%</td>
<td>15%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Fig. 6a: showing the percentage of satisfaction of the surgeons for the EQUIVET
Fig. 6b: showing the percentage of satisfaction of the surgeons for the HAICO TELGTE II

Fig. 7a: showing the percentage of satisfaction of the anaesthetists for the EQUIVET
Fig. 7b: showing the percentage of satisfaction of the anaesthetists for the HAICO TELGTE II

In conclusion the HAICO TELGTE II table scored for moderate satisfaction of the surgeons significantly more often than the EQUIVET table. The moderate satisfaction of the anaesthetists is not significantly higher on any table.

**Pedometric Measurements**

**EQUIVET**

The range for the number of steps of the surgeon was 98 to 1254 (n= 22). The mean was 443 and the standard deviation was 300.

The range for the number of steps of the assistant was 66 to 743 (n= 15). The mean was 322 and the standard deviation was 207.

**HAICO TELGTE II**

The range for the number of steps of the surgeon was 182 to 701 (n= 10). The mean was 390 and the standard deviation was 140.

The range for the number of steps of the assistant was 139 to 750 (n= 8). The mean was 477 and the standard deviation was 211.
A Pearson’s correlation was performed and revealed a correlation between the number of steps of the surgeon and the surgical time for both tables ($p=0.02$), but there was no correlation between the number of steps of the surgeon and the type of table ($p=0.527$). (Fig 8a)

There was a positive correlation between the number of steps of the assistant and the surgical time ($p=0.01$), but there was no correlation between number of steps of the assistant and the type of table ($p=0.058$). (Fig. 8b) For the surgeons no significant correlation could be detected.

Fig. 8a: Scatter plot with regression lines showing the relation between surgical time (min.) and number of steps (surgeon) for each table. (not significant)
Fig. 8b: Scatter plot with regression lines showing the relation between surgical time (min.) and number of steps (assistant) for each table (significant correlation)

Technical study

EQUIVET

The lowering time from the highest to the lowest position of the surgical table without and with a weight of 600 kg was 34.3 sec respectively 37.4 sec. The raising time from the lowest to the highest position without and with 600 kg was 22.0 sec and 24.5 sec.

The highest point reached with and without a weight of 600kg was 119 cm. The value for the lowest point was measured with 44cm.
The angles that were reached by tilting the surgical table into Trendelenburger and into Reverse Trendelenburger position with and without the weight of 600 kg were 7.5° and 8.8°.

The force needed to start moving the table straight forward with unengaged and engaged braking mechanism was 75 N (Newton) and 628 N. With a weight of 600 kg a force of 123 N and 1001 N was needed.

The force that was needed to start moving the table in an angle of 45° with unengaged and engaged braking mechanism was 62 N and 618 N. With a weight of 600 kg a force of 139 N and 710 N was needed.

The force that was needed to keep the unloaded table moving into the intended direction was 15 N. The force that was needed to keep the loaded table moving was not measured.

**HAICO TELGTE II**

The lowering time from the highest to the lowest position of the surgical table without and with a weight of 600 kg was 18.2 sec and 6.4 sec. The raising time from the lowest to the highest position without and with 600 kg was 30.3 sec and 33.3 sec.

The measurement results for the highest point without and with a weight of 600 kg showed that a height of 114.0 cm and 112.5 cm was reached. The values were measured with air mattress (Snell 2000) with 122.0 cm and 120.5 cm. The values for the lowest point with and without air mattress were measured with 45.0 cm and 37.5 cm.

The angles that were reached by tilting the surgical table into Trendelenburger and into Reverse Trendelenburger position with and without the weight of 600 kg were 12.0° and 14.5°.

The force that was needed to start moving the table straight forward with unengaged and engaged braking mechanism was 47 N and 132 N. With a weight of 600 kg a force of 122 N and 418 N was needed.

The force that was needed to start moving the table in an angle of 45° with unengaged and engaged braking mechanism was 71 N and 178 N. With a weight of 600 kg a force of 214 N and 551 N was needed.

The force that was needed to keep the unloaded table moving into the intended direction was 11 N. The force that was needed to keep the loaded table moving was not measured.
<table>
<thead>
<tr>
<th></th>
<th>EQUIVET</th>
<th>HAICO TELGTE II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lowering time (sec)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>37,4</td>
<td>6,4</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>34,3</td>
<td>18,2</td>
</tr>
<tr>
<td><strong>raising time (sec)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>24,5</td>
<td>33,3</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>22,0</td>
<td>30,3</td>
</tr>
<tr>
<td><strong>highest point (cm)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>119,0</td>
<td>112,5</td>
</tr>
<tr>
<td>+ air matress</td>
<td>---</td>
<td>120,5</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>119,0</td>
<td>114,0</td>
</tr>
<tr>
<td>+ air matress</td>
<td>---</td>
<td>122,0</td>
</tr>
<tr>
<td><strong>lowest point (cm)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without air matress</td>
<td>44,0</td>
<td>37,5</td>
</tr>
<tr>
<td>+ air matress</td>
<td>---</td>
<td>45,0</td>
</tr>
<tr>
<td><strong>tilting angles (°)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Trendelenburg</td>
<td>8,8</td>
<td>14,5</td>
</tr>
<tr>
<td>Trend – Ellenburg</td>
<td>7,5</td>
<td>12</td>
</tr>
<tr>
<td><strong>force straightforward (N)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>123</td>
<td>122</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>75</td>
<td>47</td>
</tr>
<tr>
<td><strong>force straightforward (N)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ engaged brakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>1001</td>
<td>418</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>628</td>
<td>132</td>
</tr>
<tr>
<td><strong>force in a 45° angle (N)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>139</td>
<td>214</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>62</td>
<td>71</td>
</tr>
<tr>
<td><strong>force in a 45° angle (N)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ engaged brakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with 600 kg</td>
<td>710</td>
<td>551</td>
</tr>
<tr>
<td>without 600 kg</td>
<td>618</td>
<td>178</td>
</tr>
<tr>
<td><strong>force to keep table moving (N)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 4: showing the results of the technical studies for each table

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The EQUIVET table has an integrated memory foam cushion and therefore additional cushioning is not required.
4. Discussion

The biggest difference between the HAICO TELGTE II and the EQUIVET tables is the manufacturers claim that the EQUIVET table can be used without additional padding. Therefore an important question was whether it was actually possible to use the EQUIVET table without an additional mattress. In our study no problems with post anaesthetic myopathy/neuropathy syndrome (PAMS) occurred on either of the tables during the recovery period. The blood CK levels showed no significant difference for both tables. The recovery scores from 1 to 4 recorded by the anaesthetists showed no significant difference between the tables. The mean recovery times were similar with 27 min for the EQUIVET and 31 min for the HAICO TELGTE II. No problems with PAMS were recorded. Due to this fact it was not possible to demonstrate clearly whether any of the two tables had an effect on the recovery period. Furthermore the mean anaesthetical time for a recovery score of 2 (unsafe) for both tables was similar with 104 minutes at the EQUIVET and 108 minutes at the HAICO TELGTE II. The mean anaesthetical time for a recovery score of 3 (wild) for both tables was also comparable with 120 minutes at the EQUIVET and 117 minutes at the HAICO TELGTE II. This supports the assumption that longer anaesthetical time lead to a higher risk of unsafe recovery periods (LINDSAY et al. 1980; JOHNSTON et al. 1995; BIDWELL et al. 2007).

Based on these results it can be suggested that it is not necessary to use a mattress for the EQUIVET table with the 10 cm integrated memory foam padding. However numbers in this study are quite low. So it is possible that a complication with low prevalence did not show up in our limited numbers. It may be even possible to use the HAICO TELGTE II table without mattress. Historically this table has always been used with mattresses however and this has been even recommended by KLEIN (1990).

The surgery protocol proved valuable in answering questions that were asked in this study. Surgeon compliance however was not as high as wished for. Unequal numbers between the tables can be blamed on this.

The surgeons’ satisfaction for the ability to maintain comfortable posture was rated better for the EQUIVET (good 91,4 %; moderate 5,7%) than for the HAICO TELGTE II (good 55,0%; moderate 45,0%). The satisfaction with the access to the surgical field for the surgeons (EQUIVET: good 97,1%; HAICO: good 75,0%) and assistants (EQUIVET: good 88,6%; HAICO: good 75,0%) was also rated better at the EQUIVET. The positioning of the horses was preferred on the EQUIVET surgery table (good: 94,3% ; HAICO: good 80,0%). These results may be due to the fact that the side panels are flexible and can be placed exactly where they are needed along the side of the EQUIVET table. In addition to facilitate the positioning of the horse the flexible side panels also make it easier for the surgeon to find a comfortable space to stand in relation to the surgical field.
The fixation of the horses head and the fixation of the ET (endotracheal) tube was the most mentioned problem from the anaesthetists for both tables (EQUIVET: good 74.3%, moderate 14.3%, bad 5.7%; HAICO: good 70.0%, moderate 20.0%, bad 10.0%). Therefore further improvements are needed in the fixation systems for the horses head and for the ET tube on both tables.

In this study it was not possible to verify our assumption that when a person achieves a comfortable posture while working there would be less movement and a lower number of steps. With a Pearson’s correlation it was shown that there is a correlation between the surgical time and the number of steps of the surgeons (p=0.01) and their assistants (p=0.02). However there was no correlation between the number of steps of the surgeons (p=0.527) or their assistants (p=0.058) and the type of table. It should be mentioned that measurements with a commercially available pedometer are not really exact. Even the smallest of movements during performing surgery like leaning over the surgery table or assisting the main surgeon like offering some surgical instruments may be counted as a step. The author could not find any existing studies using pedometric measurements as a means of objectively evaluating „comfort“. Therefore no documented methodology could be used. Our results should therefore be viewed with caution.

The technical part of the study brought some interesting results in the area of the new scissor based, hydraulic lifting mechanism of the EQUIVET. It takes longer to lower the EQUIVET from the highest to the lowest point (37.4 sec) than the HAICO TELGTE II (6.4 sec) loaded with 600 kg. This is safer for the horse and the clinic staff. A safety valve built into the EQUIVET table prevents the table from lowering faster when it is loaded. The raising time was faster in the EQUIVET table with 24.5 sec than with 33.3 sec. This may due to the new scissor based hydraulic lifting mechanism. It should however be mentioned that the HAICO TELGTE II table tested has already seen over 8 years of service at our clinic. With the HAICO table it was possible to reach a tilting angle of 14.5° into Reverse Trendelenburger position and 12° into Trendelenburger position, which is a larger angle than with the EQUIVET (8.8° and 7.5°). It can therefore be expected that the EQUIVET has disadvantages for laparoscopic surgery and conventional surgery, where Trendelenburger position is needed.

One of the problems reported with the HAICO table was slipping of the table when the surgeon leaned against it to gain better access to the surgical field. This was addressed in the design of the EQUIVET table by incorporating rubber feet to keep it in position on the floor. The result is that it needs a stronger force to pull the EQUIVET table in a straight line (1001 N and 418 N respectively) and in a 45° angle (710 N and 551 N respectively) and might explain the complaints during surgery. In the HAICO table brakes are applied to the wheels. The wheels however are made from hard plastic which easily slip on the floor especially when the floor is wet. It would be interesting to test both tables on other floor materials to compare more data to have a more specific evaluation of the different braking
mechanism. It should be mentioned that the measurement with the digital spring balance is not very detailed.

In conclusion the design changes in the EQUIVET table appear to offer several advantages over the older design of the HAICO table: These include the possibility to rely on the inbuilt memory foam alone for preventing PAMS, the improved ability to position the horse, greater surgeon’s comfort and extended safety features. However the better range of tilt may favor the HAICO TELGTE II table.

5. Summary

In the course of a clinical study a comparison of two operating tables was conducted at the Equine Hospital for surgery and orthopedics of the Veterinary University Vienna. The surgical tables KRUUSE EQUIVET, with integrated memory foam padding, and the HAICO TELGTE II, with commonly used extra padding, were compared between April and October 2009. Thirty- five surgeries were evaluated on the EQUIVET table and 20 on the HAICO TELGTE II. The tables were compared by serial creatinkinase (CK) testing, evaluation of the recovery period, evaluation of surgeons’ and anaesthetists’ satisfaction related to the tables, pedometric measurements of the surgeons and their assistants and a technical study.

The blood CK levels showed no significant difference for both tables. The recovery period recorded by the anaesthetists showed no significant difference between the tables. In our study no problems with post anaesthetic myopathy/ neuropathy syndrome (PAMS) occurred on either of the tables during the recovery period. The surgeons’ satisfaction for the positioning of the horses, with the access to the surgical field and the ability to maintain comfortable posture were rated significant better on the EQUIVET table. The fixation of the ET (endotracheal) tube was the most mentioned problem from the anaesthetists for both tables. The pedometric measurements of the surgeons and their assistants showed no significant differences on both tables. The technical part of the study brought some interesting results, because the EQUIVET was faster at raising and slower at lowering the table. A larger tilting angle into the Trendelenburger position was reached with the HAICO TELGET II. It needs a significant stronger force to pull the EQUIVET table with and without fixed brakes straightforward and in a 45° angle.

In conclusion the EQUIVET table appear to offer several advantages over the older design of the HAICO table, but the better range of tilt may favor the HAICO TELGTE II table.

6. Zusammenfassung

Im Zuge einer klinischen Studie wurde ein Vergleich zwischen 2 Operationstischen an der Klinik der Pferdechirurgie und Orthopädie der Veterinärmedizinischen Universität Wien durchgeführt. Die Operationstische EQUIVET (Firma Kruuse) mit einer integrierten Schaumstoffmatratze und HAICO TELGTE II mit einer zusätzlichen Luftmatratze wurden im Zeitraum zwischen April und Oktober 2009 einer kritischen Prüfung unterzogen. Am Operationstisch EQUIVET wurden 35 und am HAICO TELGTE II 20 Operationen

5. References


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