Investigation looking at the repeatability of 20 Society of Master Saddlers (SMS) qualified saddle fitters' observations during static saddle fit.

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Abstract

Reason for performing the study: Saddle fit is widely considered to be a crucial factor for the health and performance of riding horses, however, there have been no studies looking at the agreement between professionals who fit and assess saddles. *Objective*: To determine the agreement between Society of Master Saddlers (SMS) Qualified Saddle Fitters (QSF) when statically fitting a saddle following the SMS guidelines. *Methods*: Twenty SMS QSF volunteers were recruited via social media and asked to statically assess the fit of the saddle following the "7 points of saddle fit" guidelines of the SMS in 10 horses. Descriptive statistics and Fleiss Kappa (as a measure of agreement beyond chance) were used to determine agreement between fitters. *Results:* Agreement varied from slight to substantial between the different saddle assessment criteria with the assessment of overall saddle fit resulting in a fair agreement of k=0.32. Substantial agreement was found for *Saddle Clearance front* (k=0.66), *top* (k=0.78), *rear* (k=0.81) Fair agreement was found for *Clearance of the saddle- side* (k=0.28) and how the *girth straps line up with girth groove* (k=0.31) and *Panel contact* (k=0.38). Slight agreement was found for *Tree width and length* (k=0.12) and *Tree length* (k=0.12). Horse height in some criteria affected agreement. *Conclusion:* Agreement varied between the standard criteria. In cases where it was difficult to visually evaluate saddle fit, agreement was lower. Further work should aim to standardize the criteria which had suboptimal agreement.

Key words agreement, observation, horse, industry, saddle

1. Introduction

Recently, equestrian tack has received more scientific interest and research has shown the effect of saddles on locomotion and how saddlery can optimise pressure distribution and improve locomotor performance [1, 2]. It has been shown that saddle position can be related to locomotion in lame horses [3] and sound horses (Guire et al. 2016 in press) and the influence that the saddle has on the horse has been previously reported, in respect of tree width [4] treeless saddles, [5]. A correctly fitted saddle should aid locomotion, provide equal distribution of pressure beneath the panel and allow the thoracolumbar to function with the vertebrae free from pressure [5]. For the rider, the saddle provides the interface between horse and rider, the platform on which the rider sits can alter their pelvic position allowing for clear and concise signals to be given to the horse [6].

Legally anybody can fit, adjust or sell saddles in the United Kingdom (UK) without holding any form of qualification in order to advise, fit, adjust or sell a saddle. The UK has a vast heritage in saddle manufacturing, design and innovation and is the only country which offers an industry recognised qualification in saddle fitting, approved by City and Guilds and provided by the Society of Master Saddlers (SMS). To become a saddle fitter, individuals have to be a member of the SMS or be employed by a member of the SMS. Individuals can enrol on an introductory saddle fitting course, then, after gaining three years of practical experience, they complete a four-day course concluding with a written and practical exam. The course aims to standardise the fitting of saddles by providing training and guidelines for saddle fitting. On successful completion, individuals become a Society of Master Saddlers Qualified Saddle Fitter (SMSQSF). To date (2016) there are two hundred and seventy-three SMSQSF of whom ninety-one reside outside the UK. QSF wishing to progress further can do so by completing various assessments in saddle, bridle and harness making spanning four years. On successful completion of these assessments they can become a qualified saddler (QS). QS can progress further; following another three years within the trade, the QS can submit an application to SMS executive committee for consideration for the highest accolade within the industry: a Master Saddler.

Saddle fitting is an art, relying on the skills of an individual to make an informed decision on whether a saddle is suitable for both horse and rider on the day of fitting. Naturally this comes with a high degree of subjectivity, due to an individual's opinion which would be shaped by experience. A parallel to this would be the assessments of lame horses, where, despite the use of standardised grading systems, one veterinarian's opinion will differ from another [7]. To the authors' knowledge, there have been no studies looking at the agreement between qualified saddle fitters.

The aim of this study was to determine the agreement of SMSQSF when statically fitting a saddle to a

horse using the SMS seven points of saddle fitting guidelines. It was hypothesised that there will be agreement between SMSQSF when fitting a saddle statically for all seven points.

2. Methods and Materials

The study was approved by the ethics and welfare committee of the first author's institution.

2.1 Horses

Ten adult horses (6 geldings, 4 mares) were recruited via social media. Inclusion criteria were that the horses displayed no obvious soundness or conformational issues, were in regular work and good to handle. Horses ranged in height at withers from 1.63-1.80m with a meanSD of 1.690.83m, age ranged from 5-22 years with a meanSD 135 years and body weight ranged from 400-600k with a meanSD 51954.25 from a variety of disciplines (*n*= 5 dressage, *n*=2 jumping, *n*=1 eventers, *n*=2 all-rounders). Participation of horses was voluntary and the owners gave informed consent for their horses to be used in the study. Owners could withdraw their horses at any point of the study.

2.2 Saddles

Ten new saddles were used (*n*=3 jump, *n*=4 dressage, *n*=3 general purpose) using a variety of brands, which were fitted to the horses, (*n*= 2 wide, *n*= 1 narrow, *n*= 7 correct) by a SMS Master Saddler and a QSF. Saddle pads, stirrups and girth were removed from the saddle.

2.3 Society of Master Saddlers Qualified Saddle Fitters

Twenty SMSQSF were recruited via social media. Participation was voluntary and on the day of testing *n*=4 withdrew their participation from the study for reasons outside the scope of this study, leaving sixteen SMSQSF, (15 females and 1 male), height ranged 5'1-5'9 with a meanSD 5'4 0.27, age ranged 30-66 years meanSD 4711 years. Experience fitting saddles ranged 3-36 years meanSD 139 years, number of years qualified ranged 1-21 years meanSD 87 years. 14 saddlers were QSF and 2 were Master Saddlers. Miles driven to study location, ranged 6-180 miles meanSD 9854 miles. *n*=14 rode competitively and *n*=2 did not ride competitively, *n*=12 were right handed and *n*=3 were left handed.

2.4 Study protocol

QSF were randomly allocated into two groups for logistical reasons and *n*=7 QSF took part in the morning session, *n*=9 QSF took part in the afternoon session. All observations were anonymized, subjects were asked to pick out an identification number from a concealed container, the number extracted was used as the saddler's identification number throughout the study. Horses were listed on cards in different orders and each QSF randomly picked a card which listed the assigned order in which they then subsequently assessed the horses. All participants were given a short presentation detailing how to complete the observation sheets.

2.5 Static Saddle Fit

Participants were asked to assess static saddle fit following the SMS '7 points of saddle fitting" (criterions).

(1) Feel - what is the general feel of the saddle
(2) Width and shape of the head
(3) Correct positioning - does the saddle sit in the correct position leaving the scapular free and not exceeding thoracic eighteen (T18)
(4) Clearance - that there is sufficient clearance of the gullet
(5) Girth straps - ensuring that the girth straps are aligned with the girth groove
(6) Balance - saddle balance and stability
(7) Panel contact - is there consistent contact of the panel on the horse's back.

Criterion three, (*correct positioning - does the saddle sit in the correct position leaving the scapular free and not exceeding thoracic eighteen (T18))* addressed two aspects: scapular positioning and tree length. As a result, these were divided into two: (3a) scapular positioning and (3b) tree length.

Criterion four, *(clearance - that there is sufficient clearance of the gullet)* addressed four aspects, clearance of the side, top, rear and front. As a result, these were divided into four: (4a) Clearance of the saddle –top, (4b) Clearance of the saddle –side, (4c) Clearance of the saddle –front, (4d) Clearance of the saddle –rear.

2.6 Verifying Observations

One SMSQSF (Master Saddler, SMS examiner and lecturer) and one SMSQSF, both with 33 years' experience, evaluated the horses and agreed on the static fit of the 10 saddles to be used in the study following the 7 points of saddle fit. Horses 1,9,4 and 5 were fitted with a saddle which was too narrow, horses 2,6 and 7 were fitted with a saddle which was too wide and horses 8,3 and 10 were fitted with a saddle which was agreed by both the SMS Master Saddler and SMS QSF to be of correct

fit. Horses 1,3,6 and 7 were fitted with saddles which were too long and horses 2,4,5,8,9 and 10 were fitted with saddles which were correct in length. Horses 2,4,6,7,8 and 10 had saddles fitted where the girth straps did not line up with the girth groove and horses 3,4,5,7 and 10 were fitted with saddles which had unsatisfactory panel contact. Their observations for each saddle and criterion were documented and used as a model to compare with the QSF observations. In accordance with ethics and with the knowledge that some of the saddles were incorrect in their fit, girthing up of saddles was omitted from the study.

2.7 Data Analysis

Fleiss Kappa statistics were calculated to assess agreement between observers; agreement was categorised <0=poor agreement, <0.20=slight agreement, <0.40=fair agreement, <0.60= moderate agreement, <0.80 substantial agreement and >1= almost perfect agreement.
To assess if there is a correlation between agreement of criteria and height of the horse Spearman's rank correlation was calculated.

3. Results

Agreement between the QSF varied between the different criteria. This study found substantial agreement for criterion 4a, *Clearance of the saddle -top* (89% k=0.78), criterion 4c, *Clearance of the saddle - front*, (83% k=0.66) and criterion 4d, *Clearance of the saddle - rear*, (90% k=0.81). Fair agreement was found for criterion 1, *Does the saddle look correct*, (66% k=0.32), criterion 4b, *Clearance of the saddle- side*, (64% k=0.28), criterion 5, *Girth straps line up with girth groove*, (65% k=0.31). Criterion 6, saddle balance and stability, was excluded as in retrospect it was found that two responses were required 1) saddle balance, 2) saddle stability, and our response form did not have scope to determine the difference between the two aspects so it was decided to excluded this criterion. Criterion 7, *Panel contact*, (69% k=0.38). There was moderate agreement for criterion 3a, (71% k=0.42). For criterion 2, *Tree width and length*, (57% k=0.12) and criterion 3b, *Tree length* (56% k=0.12) slight agreement was found between the QSF (table 1).

There was no significant correlation between horse height and criterion 1, *Does the saddle look correct*, (ρ=0.13), criterion 3b, *Tree length*, (ρ=-0.14), Criterion 4a, *Clearance of the saddle –top*, (ρ=0.21), criterion 4c, *Clearance of the saddle – front*, (ρ=0.16), criterion 4d, *Clearance of the saddle – rear*, (ρ=0.09), criterion 5, *Girth straps line up with girth groove*, (ρ=0.01) and criterion 7, *Panel contact*, (ρ=0.20). There was a negative correlation between criterion 2, *Tree width, shape of the head, angle and space between side rails and length of tree* (ρ=-0.44) and horse height, and a positive correlation between criterion 4b, *Clearance of the saddle – side*, (ρ=0.42) and horse height.

220 *Table 1- QSF Agreement from sixteen SMSQSF when observing ten horses for static saddle fit*
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Criterion	Observed Agreement	Fleiss Kappa	
Criterion 1 *Does the saddle look correct*	66%	0.32	Fair Agreement
Criterion 2 *Tree width and shape of the head*	57%	0.12	Slight agreement
Criterion 3 A *Scapula positioning*	71%	0.42	Moderate agreement
Criterion 3 B *Tree length*	56%	0.12	Slight agreement
Criterion 4a *Clearance of the saddle -top*	89%	0.78	Substantial agreement
Criterion 4b *Clearance of the saddle - side*	64%	0.28	Fair agreement
Criterion 4c *Clearance of the saddle - front*	83%	0.66	Substantial agreement
Criterion 4d *Clearance of the saddle - rear*	90%	0.81	Substantial agreement
Criterion 5 *Girth straps line up with girth groove*	65%	0.31	Fair agreement
Criterion 6 *Balance and stability of the saddle*	-	-	-
Criterion 7 *Panel contact*	69%	0.38	Fair agreement

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224 ***4. Discussion***
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226 The influence that the saddle has on equine locomotion and the need for correctly fitting equipment in
227 order to optimise the horse-rider system has previously been reported [1, 2, 8, 9]. The challenge of
228 saddle fitting relies on the opinion of an individual who is not legally required to hold any
229 qualification or training. The SMS have made advances, providing training and formal qualifications
230 creating a network of QSF who can independently fit, advise and adjust saddles. The object of this
231 study was to evaluate the agreement between twenty QSF statically fitting a saddle following the
232 SMS guidelines, the “seven points of saddle fit”. A parallel to this would be the assessment of lame

horses, where, despite the use of standardised grading systems, one veterinarian's opinion will differ from another [7].

In respect to the hypothesis, it was found that there was agreement between the QSF, however, agreement varied between each criterion. These differences highlight the challenges of saddle fit in the absence of objective measures. In cases where the criterion was visually easy to evaluate, as in the case of criterion 4a, *clearance of the saddle – top, front and rear* there was substantial agreement between the QSF. The saddle should not interfere with the scapular mechanics statically nor dynamically, to do so would compromise the locomotion of the horse. Current guidelines are that the tree points correspond to the angle of the horse's back five centimetres from the caudal edge of the scapular in the static horse, this should allow for optimal function of the scapular. This study found moderate agreement for criterion 3a, *scapular positioning*, the scapular is palpable providing a reference point for the QSF when assessing the saddle fit. Detailed anatomical training maybe advantageous during the QSF training programme, as given the lateral extremities of the scapular being visible, along with the ability to palpate, it is reasonable to assume that agreement could be substantial as opposed to moderate.

As part of the seven points of saddle fitting, the QSF has to make an initial assessment of the saddle on the horse's back, criterion 1, *does the saddle look correct*, the guidelines are that after subjectively evaluating the initial placement of the saddle on the horse, the QSF simply determines if the saddle is suitable or not. This criterion, further highlighting the subjectivity of saddle fitting, is supported by our study finding fair agreement between the QSF for criterion 1. Previously, substantial agreement was observed for criterions where the QSF had the ability to visually evaluate key parameters as was the case with criterion 4a and 3a. However, when criteria were visually restricted as in the case of criterion 4b – *clearance of saddle – side*, only fair agreement was found. To assess clearance of the saddle - side, the QSF has to visually check the clearance of the panel in relation to the spinous process, laterally, in conjunction with running their hand beneath the panel and feeling for its contact with the horse's back. Agreement could be affected by varying techniques used by the QSF to evaluate the panel along with height of the horse; as this study found that agreement was altered with horses who were taller at the wither, thus altering the QSF eye level, distorting the view and potentially reducing the ability to visually assess the saddle in relation to the horse's back.

This study has shown that when the QSF can visually assess a criterion, agreement is higher compared to when visibility of a criterion is absent. Although agreement seems to be influenced by visibility of the criterion, this is not the case with criterion 5, *girth straps line up with girth groove*. The current guidelines are when the saddle flap is lifted when the saddle is positioned correctly, the girth straps should come down vertically to align with the girth groove. The girth groove is not

visually obscured therefore it is reasonable to assume that agreement is not solely related to visibility. Agreement would be affected by the overall positioning of the saddle, with some QSF positioning the saddle cranially or caudally to the correct area thus affecting the vertical orientation of the girth strap. This study, along with current training, could further be improved with a criterion evaluating saddle placement, by standardizing saddle placement it would allow an appropriate evaluation of the agreement found for criterion 5.

Panel contact provides the interface between the horse and the saddle construction. The current guidelines, if flocked, is the flocking should be sufficient to give clearance and provide a cushioning effect, but should not be hard or irregular in form, the panel should have a large bearing area which supports the tree. The panels are evaluated on the horse and this study found fair agreement, but it could be argued that agreement is low given the ease at visually evaluating and palpating the panel. Although this study did not find any correlation between horse height and saddler height, it is possible that a shorter saddler's eye line could have been distorted thus affecting their evaluation, more research is needed to determine if this is the case.

Tree width is subjective and based on experience, rather than objective measures, with some saddlers preferring to fit trees "slightly" wider, with the opinion that by doing so, it allows the horse's thoracolumbar to increase in size as a result of ridden exercise or after a period of training. Changes in thoracolumbar size have been reported after ridden exercises with correctly fitted saddles, [10, 11] more work is needed to establish if fitting a wider tree is ideal for thoracolumbar function. Tree width has been investigated [12] where saddles were categorized in to four groups, correct width (which was determined by the saddle with lowest overall force) and too narrow, too wide and excessively wide. With each group there were changes in pressures beneath the saddle. Although there is evidence on the effect of tree widths, further research is needed in order to update current practice. The variations of opinions and lack of evidence could explain why our study only found slight agreement between the QSF for criterion 2 *tree width, shape of the head, angle and space between side rails and length of tree*. Further research will allow current practice to be reviewed until which time, the current guidelines are that the angle of the points correspond to the angle of the horse's back five centimetres from the caudal edge of the scapular in the static horse.

Similar to tree width, tree length proposes similar challenges in respect to subjectivity. The current guidelines for *tree length*, Criterion 3b, are that the tree does not exceed thoracic eighteen (T18) although the panel may. The acceptance that the panel may exceed T18 is explained by the assumption that the vertical force is less at the most caudal point of the panel compared to the most caudal point of the tree. QSF have the ability to palpate the most caudal rib then following the rib dorsally to the vertebra providing an approximation for T18 or alternatively, by identifying the lumbar

vertebra and then palpating cranially until the thoracic vertebra also provides an approximation for T18. Despite these two methods, this study found slight agreement between the QSF. This could be explained by inability to visually evaluate the end of the tree, as the tree is housed within the panel. The most caudal edge of the panel does not relate to tree length, as a result true tree length would be hard to quantify given the visual limitation. There are no published studies quantifying the effect of tree length in relation to T18, given the disparity between opinion, further research is needed.

The authors appreciate that this study has evaluated the seven points of saddle fitting statically and in current practice an informed decision would not be made solely based on static fit but in conjunction with a dynamic (ridden) assessment, however, given that the some of the saddles were out of balance, assessing them dynamically would have contravened ethics and therefore it was decided to only evaluate saddles statically. The authors appreciate that QSF are required to carry out templates of the horse's back before fitting saddles. Due to time constraints, this was not included in the study thus could have affected agreement. The authors also appreciate that QSF are required to stock at least three different brands of saddles. Despite this study using a variety of brands, it could be that the QSF were not familiar with the saddles used in the study. Although unlikely, this unfamiliarity could have affected agreement. This study could be further improved by increasing the number of horses and recruiting a greater number of QSF and developing a model to evaluate dynamic observations. Also it could be improved further by division of all criteria as criterion 6, *saddle balance and stability*, retrospectively required two responses 1) saddle balance, 2) saddle stability. As our response form did not have scope to determine the difference between the two aspects, responses were excluded for this criterion. The statistics used provide estimates which are arbitrary however, provide useful benchmarks providing the limitations of using kappa to estimate agreement are considered. An important limitation is that calculating kappa assumes a quantification of chance agreement, which is relevant only under conditions of statistical independence of the raters [7].

5. Conclusion

This study found that there was agreement between SMSQSF when statically fitting a saddle to a horse following the SMS seven points of saddle fit. Agreement varied between the criteria and improved when the QSF had the ability to visually evaluate the fit of the saddle. In cases where it was difficult to visually evaluate saddle fit, agreement was lower. This study has found a disparity between opinions on tree width and tree length warranting the need for further research evaluating the impact that either has on equine locomotion. With this information, current practices can be reviewed accordingly.

6. Conflict of Interest Statements

None of the authors of this paper has a financial or personal relationship with other people or organization that could inappropriately influence or bias the content of this paper. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Highlights

1. Agreement was found for criterions during static saddle fitting.
2. Criterion, tree width and tree length showed lowest agreement.
3. Impact of tree width and tree length requires further research
4. Horse height affected agreement for tree width and saddle clearance.