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

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56 **Abstract**

57

58 *Reason for performing the study:* Saddle fit is widely considered to be a crucial factor for the health

59 and performance of riding horses, however, there have been no studies looking at the agreement

60 between professionals who fit and assess saddles. *Objective*: To determine the agreement between

61 Society of Master Saddlers (SMS) Qualified Saddle Fitters (QSF) when statically fitting a saddle

62 following the SMS guidelines. *Methods*: Twenty SMS QSF volunteers were recruited via social media

63 and asked to statically assess the fit of the saddle following the "7 points of saddle fit" guidelines of

64 the SMS in 10 horses. Descriptive statistics and Fleiss Kappa (as a measure of agreement beyond

65 chance) were used to determine agreement between fitters. *Results:* Agreement varied from slight to

66 substantial between the different saddle assessment criteria with the assessment of overall saddle fit

67 resulting in a fair agreement of k=0.32. Substantial agreement was found for *Saddle Clearance front*

68 (k=0.66), *top* (k=0.78), *rear* (k=0.81) Fair agreement was found for *Clearance of the saddle- side*

69 (k=0.28) and how the *girth straps line up with girth groove* (k=0.31) and *Panel contact* (k=0.38).

70 Slight agreement was found for *Tree width and length* (k=0.12) and *Tree length* (k=0.12). Horse

71 height in some criteria affected agreement. *Conclusion:* Agreement varied between the standard

72 criteria. In cases where it was difficult to visually evaluate saddle fit, agreement was lower. Further

73 work should aim to standardize the criteria which had suboptimal agreement.

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75 *Key words agreement, observation, horse, industry, saddle*

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2

77   **1. Introduction**

78

79   Recently, equestrian tack has received more scientific interest and research has shown the effect of

80   saddles on locomotion and how saddlery can optimise pressure distribution and improve locomotor

81   performance [1, 2]. It has been shown that saddle position can be related to locomotion in lame horses

82   [3] and sound horses (Guire et al. 2016 in press) and the influence that the saddle has on the horse has

83   been previously reported, in respect of tree width [4] treeless saddles, [5]. A correctly fitted saddle

84   should aid locomotion, provide equal distribution of pressure beneath the panel and allow the

85   thoracolumbar to function with the vertebrae free from pressure [5]. For the rider, the saddle provides

86   the interface between horse and rider, the platform on which the rider sits can alter their pelvic

87   position allowing for clear and concise signals to be given to the horse [6].

88

89   Legally anybody can fit, adjust or sell saddles in the United Kingdom (UK) without holding any form

90   of qualification in order to advise, fit, adjust or sell a saddle. The UK has a vast heritage in saddle

91   manufacturing, design and innovation and is the only country which offers an industry recognised

92   qualification in saddle fitting, approved by City and Guilds and provided by the Society of Master

93   Saddlers (SMS). To become a saddle fitter, individuals have to be a member of the SMS or be

94   employed by a member of the SMS. Individuals can enrol on an introductory saddle fitting course,

95   then, after gaining three years of practical experience, they complete a four-day course concluding

96   with a written and practical exam. The course aims to standardise the fitting of saddles by providing

97   training and guidelines for saddle fitting. On successful completion, individuals become a Society of

98   Master Saddlers Qualified Saddle Fitter (SMSQSF). To date (2016) there are two hundred and

99   seventy-three SMSQSF of whom ninety-one reside outside the UK. QSF wishing to progress further

100   can do so by completing various assessments in saddle, bridle and harness making spanning four

101   years. On successful completion of these assessments they can become a qualified saddler (QS). QS

102   can progress further; following another three years within the trade, the QS can submit an application

103   to SMS executive committee for consideration for the highest accolade within the industry: a Master

104   Saddler.

105

106   Saddle fitting is an art, relying on the skills of an individual to make an informed decision on whether

107   a saddle is suitable for both horse and rider on the day of fitting. Naturally this comes with a high

108   degree of subjectivity, due to an individual's opinion which would be shaped by experience. A

109   parallel to this would be the assessments of lame horses, where, despite the use of standardised

110   grading systems, one veterinarian's opinion will differ from another [7]. To the authors' knowledge,

111   there have been no studies looking at the agreement between qualified saddle fitters.

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

113 horse using the SMS seven points of saddle fitting guidelines. It was hypothesised that there will be

114 agreement between SMSQSF when fitting a saddle statically for all seven points.

115

116 **2. Methods and Materials**

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

118 *2.1 Horses*

119

120 Ten adult horses (6 geldings, 4 mares) were recruited via social media. Inclusion criteria were that the

121 horses displayed no obvious soundness or conformational issues, were in regular work and good to

122 handle. Horses ranged in height at withers from 1.63-1.80m with a meanSD of 1.690.83m, age ranged

123 from 5-22 years with a meanSD 135 years and body weight ranged from 400-600k with a meanSD

124 51954.25 from a variety of disciplines (*n*= 5 dressage, *n*=2 jumping, *n*=1 eventers, *n*=2 all-rounders).

125 Participation of horses was voluntary and the owners gave informed consent for their horses to be

126 used in the study. Owners could withdraw their horses at any point of the study.

127

128 *2.2 Saddles*

129

130 Ten new saddles were used (*n*=3 jump, *n*=4 dressage, *n*=3 general purpose) using a variety of brands,

131 which were fitted to the horses, (*n*= 2 wide, *n*= 1 narrow, *n*= 7 correct) by a SMS Master Saddler and

132 a QSF. Saddle pads, stirrups and girth were removed from the saddle.

133

134 *2.3 Society of Master Saddlers Qualified Saddle Fitters*

135

136 Twenty SMSQSF were recruited via social media. Participation was voluntary and on the day of

137 testing *n*=4 withdrew their participation from the study for reasons outside the scope of this study,

138 leaving sixteen SMSQSF, (15 females and 1 male), height ranged 5'1-5'9 with a meanSD 5'4 0.27,

139 age ranged 30-66 years meanSD 4711 years. Experience fitting saddles ranged 3-36 years meanSD

140 139 years, number of years qualified ranged 1-21 years meanSD 87 years. 14 saddlers were QSF and

141 2 were Master Saddlers. Miles driven to study location, ranged 6-180 miles meanSD 9854 miles.

142 *n*=14 rode competitively and *n*=2 did not ride competitively, *n*=12 were right handed and *n*=3 were

143 left handed.

144

145

146 *2.4 Study protocol*

147

4

148 QSF were randomly allocated into two groups for logistical reasons and *n*=7 QSF took part in the

149 morning session, *n*=9 QSF took part in the afternoon session. All observations were anonymized,

150 subjects were asked to pick out an identification number from a concealed container, the number

151 extracted was used as the saddler's identification number throughout the study. Horses were listed on

152 cards in different orders and each QSF randomly picked a card which listed the assigned order in

153 which they then subsequently assessed the horses. All participants were given a short presentation

154 detailing how to complete the observation sheets.

155

156 *2.5 Static Saddle Fit*

157

158 Participants were asked to assess static saddle fit following the SMS '7 points of saddle fitting"

159 (criterions).

160 (1) Feel - what is the general feel of the saddle

161 (2) Width and shape of the head

162 (3) Correct positioning - does the saddle sit in the correct position leaving the scapular free and not

163 exceeding thoracic eighteen (T18)

164 (4) Clearance - that there is sufficient clearance of the gullet

165 (5) Girth straps - ensuring that the girth straps are aligned with the girth groove

166 (6) Balance - saddle balance and stability

167 (7) Panel contact - is there consistent contact of the panel on the horse's back.

168

169 Criterion three, (*correct positioning - does the saddle sit in the correct position leaving the scapular*

170 *free and not exceeding thoracic eighteen (T18))* addressed two aspects: scapular positioning and tree

171 length. As a result, these were divided into two: (3a) scapular positioning and (3b) tree length.

172

173 Criterion four, *(clearance - that there is sufficient clearance of the gullet)* addressed four aspects,

174 clearance of the side, top, rear and front. As a result, these were divided into four: (4a) Clearance of

175 the saddle –top, (4b) Clearance of the saddle –side, (4c) Clearance of the saddle –front, (4d)

176 Clearance of the saddle –rear.

177

178 2.6 Verifying Observations

179 One SMSQSF (Master Saddler, SMS examiner and lecturer) and one SMSQSF, both with 33 years'

180 experience, evaluated the horses and agreed on the static fit of the 10 saddles to be used in the study

181 following the 7 points of saddle fit. Horses 1,9,4 and 5 were fitted with a saddle which was too

182 narrow, horses 2,6 and 7 were fitted with a saddle which was too wide and horses 8,3 and 10 were

183 fitted with a saddle which was agreed by both the SMS Master Saddler and SMS QSF to be of correct

184 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

185 fitted with saddles which were correct in length. Horses 2,4,6,7,8 and 10 had saddles fitted where the

186 girth straps did not line up with the girth groove and horses 3,4,5,7 and 10 were fitted with saddles

187 which had unsatisfactory panel contact. Their observations for each saddle and criterion were

188 documented and used as a model to compare with the QSF observations. In accordance with ethics

189 and with the knowledge that some of the saddles were incorrect in their fit, girthing up of saddles was

190 omitted from the study.

191   *2.7 Data Analysis*

192

193 Fleiss Kappa statistics were calculated to assess agreement between observers; agreement was

194 categorised <0=poor agreement, <0.20=slight agreement, <0.40=fair agreement, <0.60= moderate

195 agreement, <0.80 substantial agreement and >1= almost perfect agreement.

196 To assess if there is a correlation between agreement of criteria and height of the horse Spearman's

197 rank correlation was calculated.

198

199 **3. Results**

200

201 Agreement between the QSF varied between the different criteria. This study found substantial

202 agreement for criterion 4a, *Clearance of the saddle -top* (89% k=0.78), criterion 4c, *Clearance of the*

203 *saddle - front*, (83% k=0.66) and criterion 4d, *Clearance of the saddle - rear*, (90% k=0.81). Fair

204 agreement was found for criterion 1, *Does the saddle look correct,* (66% k=0.32), criterion 4b,

205 *Clearance of the saddle- side,* (64% k=0.28), criterion 5, *Girth straps line up with girth groove*, (65%

206 k=0.31). Criterion 6, saddle balance and stability, was excluded as in retrospect it was found that two

207 responses were required 1) saddle balance, 2) saddle stability, and our response form did not have

208 scope to determine the difference between the two aspects so it was decided to excluded this criterion.

209 Criterion 7, *Panel contact,* (69% k=0.38). There was moderate agreement for criterion 3a, (71%

210 k=0.42). For criterion 2, *Tree width and length*, (57% k=0.12) and criterion 3b, *Tree length* (56%

211 k=0.12) slight agreement was found between the QSF (table 1).

212

213 There was no significant correlation between horse height and criterion 1, *Does the saddle look*

214 *correct,* (ρ=0.13), criterion 3b, *Tree length*, (ρ=-0.14), Criterion 4a, *Clearance of the saddle –top,*

215 (ρ=0.21), criterion 4c, *Clearance of the saddle – front,* (ρ=0.16), criterion 4d, *Clearance of the saddle*

216 *– rear,* (ρ=0.09), criterion 5, *Girth straps line up with girth groove*, (ρ=0.01) and criterion 7, *Panel*

217 *contact*, (ρ=0.20). There was a negative correlation between criterion 2, *Tree width, shape of the*

218 *head, angle and space between side rails and length of tree* (ρ=-0.44) and horse height, and a positive

219 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*

221

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

222

223

224 ### 4. Discussion

225

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

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

235 In respect to the hypothesis, it was found that there was agreement between the QSF, however,
236 agreement varied between each criterion. These differences highlight the challenges of saddle fit in
237 the absence of objective measures. In cases where the criterion was visually easy to evaluate, as in the
238 case of criterion 4a, *clearance of the saddle – top, front and rear* there was substantial agreement
239 between the QSF. The saddle should not interfere with the scapular mechanics statically nor
240 dynamically, to do so would compromise the locomotion of the horse. Current guidelines are that the
241 tree points correspond to the angle of the horse's back five centimetres from the caudal edge of the
242 scapular in the static horse, this should allow for optimal function of the scapular. This study found
243 moderate agreement for criterion 3a, *scapular positioning*, the scapular is palpable providing a
244 reference point for the QSF when assessing the saddle fit. Detailed anatomical training maybe
245 advantageous during the QSF training programme, as given the lateral extremities of the scapular
246 being visible, along with the ability to palpate, it is reasonable to assume that agreement could be
247 substantial as opposed to moderate.
248
249 As part of the seven points of saddle fitting, the QSF has to make an initial assessment of the saddle
250 on the horse's back, criterion 1, *does the saddle look correct*, the guidelines are that after subjectively
251 evaluating the initial placement of the saddle on the horse, the QSF simply determines if the saddle is
252 suitable or not. This criterion, further highlighting the subjectivity of saddle fitting, is supported by
253 our study finding fair agreement between the QSF for criterion 1. Previously, substantial agreement
254 was observed for criterions where the QSF had the ability to visually evaluate key parameters as was
255 the case with criterion 4a and 3a. However, when criteria were visually restricted as in the case of
256 criterion 4b – *clearance of saddle – side*, only fair agreement was found. To assess clearance of the
257 saddle - side, the QSF has to visually check the clearance of the panel in relation to the spinous
258 process, laterally, in conjunction with running their hand beneath the panel and feeling for its contact
259 with the horse's back. Agreement could be affected by varying techniques used by the QSF to
260 evaluate the panel along with height of the horse; as this study found that agreement was altered with
261 horses who were taller at the wither, thus altering the QSF eye level, distorting the view and
262 potentially reducing the ability to visually assess the saddle in relation to the horse's back.
263
264 This study has shown that when the QSF can visually assess a criterion, agreement is higher
265 compared to when visibility of a criterion is absent. Although agreement seems to be influenced by
266 visibility of the criterion, this is not the case with criterion 5, *girth straps line up with girth groove*.
267 The current guidelines are when the saddle flap is lifted when the saddle is positioned correctly, the
268 girth straps should come down vertically to align with the girth groove. The girth groove is not

269 visually obscured therefore it is reasonable to assume that agreement is not solely related to visibility.

270 Agreement would be affected by the overall positioning of the saddle, with some QSF positioning the

271 saddle cranially or caudally to the correct area thus affecting the vertical orientation of the girth strap.

272 This study, along with current training, could further be improved with a criterion evaluating saddle

273 placement, by standardizing saddle placement it would allow an appropriate evaluation of the

274 agreement found for criterion 5.

275

276 Panel contact provides the interface between the horse and the saddle construction. The current

277 guidelines, if flocked, is the flocking should be sufficient to give clearance and provide a cushioning

278 effect, but should not be hard or irregular in form, the panel should have a large bearing area which

279 supports the tree. The panels are evaluated on the horse and this study found fair agreement, but it

280 could be argued that agreement is low given the ease at visually evaluating and palpating the panel.

281 Although this study did not find any correlation between horse height and saddler height, it is possible

282 that a shorter saddler's eye line could have been distorted thus affecting their evaluation, more

283 research is needed to determine if this is the case.

284

285 Tree width is subjective and based on experience, rather than objective measures, with some saddlers

286 preferring to fit trees "slightly" wider, with the opinion that by doing so, it allows the horse's

287 thoracolumbar to increase in size as a result of ridden exercise or after a period of training. Changes in

288 thoracolumbar size have been reported after ridden exercises with correctly fitted saddles, [10, 11]

289 more work is needed to establish if fitting a wider tree is ideal for thoracolumbar function. Tree width

290 has been investigated [12] where saddles were categorized in to four groups, correct width (which was

291 determined by the saddle with lowest overall force) and too narrow, too wide and excessively wide.

292 With each group there were changes in pressures beneath the saddle. Although there is evidence on

293 the effect of tree widths, further research is needed in order to update current practice. The variations

294 of opinions and lack of evidence could explain why our study only found slight agreement between

295 the QSF for criterion 2 *tree width, shape of the head, angle and space between side rails and length of*

296 *tree*. Further research will allow current practice to be reviewed until which time, the current

297 guidelines are that the angle of the points correspond to the angle of the horse's back five centimetres

298 from the caudal edge of the scapular in the static horse.

299 Similar to tree width, tree length proposes similar challenges in respect to subjectivity. The current

300 guidelines for *tree length*, Criterion 3b, are that the tree does not exceed thoracic eighteen (T18)

301 although the panel may. The acceptance that the panel may exceed T18 is explained by the

302 assumption that the vertical force is less at the most caudal point of the panel compared to the most

303 caudal point of the tree. QSF have the ability to palpate the most caudal rib then following the rib

304 dorsally to the vertebra providing an approximation for T18 or alternatively, by identifying the lumbar

305 vertebra and then palpating cranially until the thoracic vertebra also provides an approximation for

306 T18. Despite these two methods, this study found slight agreement between the QSF. This could be

307 explained by inability to visually evaluate the end of the tree, as the tree is housed within the panel.

308 The most caudal edge of the panel does not relate to tree length, as a result true tree length would be

309 hard to quantify given the visual limitation. There are no published studies quantifying the effect of

310 tree length in relation to T18, given the disparity between opinion, further research is needed.

311 The authors appreciate that this study has evaluated the seven points of saddle fitting statically and in

312 current practice an informed decision would not be made solely based on static fit but in conjunction

313 with a dynamic (ridden) assessment, however, given that the some of the saddles were out of balance,

314 assessing them dynamically would have contravened ethics and therefore it was decided to only

315 evaluate saddles statically. The authors appreciate that QSF are required to carry out templates of the

316 horse's back before fitting saddles. Due to time constraints, this was not included in the study thus

317 could have affected agreement. The authors also appreciate that QSF are required to stock at least

318 three different brands of saddles. Despite this study using a variety of brands, it could be that the QSF

319 were not familiar with the saddles used in the study. Although unlikely, this unfamiliarity could have

320 affected agreement. This study could be further improved by increasing the number of horses and

321 recruiting a greater number of QSF and developing a model to evaluate dynamic observations. Also it

322 could be improved further by division of all criteria as criterion 6, *saddle balance and stability,*

323 retrospectively required two responses 1) saddle balance, 2) saddle stability. As our response form

324 did not have scope to determine the difference between the two aspects, responses were excluded for

325 this criterion. The statistics used provide estimates which are arbitrary however, provide useful

326 benchmarks providing the limitations of using kappa to estimate agreement are considered. An

327 important limitation is that calculating kappa assumes a quantification of chance agreement, which is

328 relevant only under conditions of statistical independence of the raters [7].

329
330
331 *5. Conclusion*

332

333 This study found that there was agreement between SMSQSF when statically fitting a saddle to a

334 horse following the SMS seven points of saddle fit. Agreement varied between the criteria and

335 improved when the QSF had the ability to visually evaluate the fit of the saddle. In cases where it was

336 difficult to visually evaluate saddle fit, agreement was lower. This study has found a disparity

337 between opinions on tree width and tree length warranting the need for further research evaluating the

338 impact that either has on equine locomotion. With this information, current practices can be reviewed

339 accordingly.

340

341

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389

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.