Long term effects of treatment and management approaches for impinging dorsal spinous processes in ridden horses

Treatment and management of IDSP

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Summary

Background: Impinging dorsal spinous processes (IDSP) are a common cause of pain and loss of performance in sports horses, with a range of surgical and conservative treatments available.

Objectives: Identify relationships between treatment choice and the likelihood of returning to previous level of performance for horses diagnosed with IDSP.

Study design: Cross sectional survey of owners with horses diagnosed with IDSP.

Methods: A 14-question online survey was circulated via social media. Data were collected for 260 horses and analysed for associations between treatment choice and return to pre-diagnosis level of performance.

Results: Just under 50% of horses in the sample returned to their previous level of performance post-treatment. Horses that were treated surgically had twice the odds of returning to their previous level than those that were not, and horses that underwent an exercise rehabilitation programme had 10 times the odds of returning to level.

Main limitations: As this was an owner survey, self-selection bias and recall bias could have influenced the findings.

Conclusions: If the aim is for the horse to return to a competitive career post-treatment, the most appropriate surgical intervention appears to be the best approach, and an exercise rehabilitation plan may have benefit.

Keywords: Horse; Kissing spines; Surgery; Physiotherapy; Rehabilitation

Clinical Relevance:

- Horses that were treated surgically for IDSP had higher odds of returning to their previous level of performance than those receiving only non-surgical treatments
- Correct exercise prescription has potential to improve the outcome for ridden horses with IDSP and warrants further research
- Additional musculoskeletal pathologies were reported in 61% of horses with IDSP and were associated with reduced odds of returning to previous performance level

Introduction

The equine vertebral column provides a crucial foundation for structural support, movement, and athletic performance (Stubbs *et al*., 2006) however back pain is a commonly reported concern, with impinging dorsal spinal processes (IDSP) as the most common cause (Jeffcott, 1979; Jacklin *et al*., 2014; Henson, 2017). Interspinous spaces (ISS) below 4 mm are considered clinically significant (Erichsen *et al*., 2004; Sinding and Berg, 2010; Coomer *et al*., 2012) and are frequently identified within the thoracic and occasionally the lumbar region (Dyson and Ross, 2011; Zimmerman, 2012; Clayton and Stubbs, 2016). The abnormality ranges from close summits to over-riding processes with regions of active remodelling and bone fusion (Zimmerman *et al.,* 2011; Sinding and Berg, 2010).

Numerous treatment and management options exist for IDSP, with conservative management methods primarily selected after initial diagnosis to reduce localised pain and develop epaxial musculature (Stubbs, 2011). Corticosteroid injections or non-steroidal anti-inflammatory drug (NSAID) administration aim to reduce inflammation in ISS to support implementing a rehabilitation programme (Turner, 2011). Earlier surgical treatment included resection of the spinal processes, with a reported 72% of horses returning to full work post-surgery (Walmsley *et al*., 2002), however the required general anaesthesia supported standing surgery options with Brink (2014) reporting subtotal ostectomy had 86% of horses returning to work. More recently, a minimally invasive technique, interspinous ligament desmotomy (ISLD), designed to reduce stimulation associated with sensory nerves, has reported alleviation of back pain in over 90% of cases (Prisk and Garcia-Lopez, 2019; Coomer *et al*., 2012) and a shortened return to work time of six weeks (Coomer *et al*., 2012).

Previous studies have included follow up of horses treated with specific techniques within one clinic, but to date there has been no investigation of the long-term impact of treatment selection

on performance across a range of treatment approaches. This study aimed to investigate the relationship between treatment choices and long-term performance of ridden horses diagnosed with IDSP.

Materials and methods

A cross-sectional study was undertaken between December 2019 and February 2020, using a convenience sampling method to survey owners of horses diagnosed with IDSP. A 14-question online survey (supplementary material) was distributed via the social media platform Facebook, into two groups, 'Horses with Kissing Spine' and 'Horses with Arthritis and Related Conditions' which at the time of circulation had 7,024 and 2,125 members, respectively. Ethical approval for the project was granted by Bishop Burton College Ethics and Welfare Committee. All participants remained anonymous and all data were stored securely and in accordance with the General Data Protection Regulation (2016) and Data Protection Act (2018).

Data collected on the pathology included number of affected vertebrae, regions(s) of the spine affected, and if the horse had been diagnosed with any additional musculoskeletal pathologies. Treatments used were selected from a list. Multiple selections were allowed and an 'other' option allowed owners to write in additional treatment types. Where several respondents wrote in similar treatments, new categories were created. Whether the horse returned to its pre-diagnosis level of performance after receiving treatment was a binary (Yes/No) question. Information on the horses' age at diagnosis and breed were also ascertained to determine the cross-section of horses being represented.

Survey data were coded into IBM SPSS v28 for analysis. Binary logistic regression was used to assess relationships between reported pathology and treatment selection, between pathology

and whether the horse returned to its previous level of performance, and between treatment selection and return to level. Alpha was set at 0.05.

Results

A total of 265 complete questionnaires were received, a response rate of 2.9%. However, some of the distribution list will likely be duplicates (members of both groups), so true response rate may be higher. Of these, five owners indicated that their horses were diagnosed with muscular or arthritic changes to the spine, but not IDSP, and so were not included in the sample, leaving 260 responses for analysis.

Owners reported the age at which their horse was diagnosed with IDSP, with 41% of the sample being diagnosed between 7-10 years of age, and 93% between 3-14 years of age. Thoroughbreds and Warmbloods made up the largest proportion of the sample, 35% and 27.3% respectively, and other sports horses including crossbreeds made up a further 16.2%. The remaining 21.5% was made up of a range of breeds including cobs, British native breeds, Arabians, and their crosses.

The median number of affected vertebrae was 4±2 (±IQR). It was reported that 8.1% of the sample had pathology in the cranial thoracic region (T1-T9), 58.8% in the caudal thoracic (T10-T18), 7.3% in the lumbar, and 25.8% had pathologies in more than one of the defined regions. Almost fifty percent (n=129) of the horses returned to their previous level of performance after receiving treatment.

The range of treatments reported can be seen in Figure 1. The majority of categories used were pre-defined, but new categories were added based on write-in answers for manual therapy (other than physiotherapy e.g. chiropractic, osteopathy), exercise rehabilitation (exercise plan, which may be developed by a physiotherapist, veterinarian, or other professional), and NSAIDs, which were not specified on the original list of treatments. It was reported that 35.4%

of the sample received one type of treatment, 36.2% received two categories of treatment, 20.8% received three types of treatment, and 4.6% received four or more different treatments. Owners reported that 8 horses (3.1%) received none of the defined treatment types. Several owners used the 'other' option on the survey to write in alternative treatments, but numbers of some of these write-in treatments were too small to form groups in the analysis.

[Figure 1 near here]

At least one additional pathology was reported in 60.8% of horses in the sample. These secondary diagnoses included tarsal pathologies (36.2% of all horses in sample), sacroiliac pain (29.3%), suspensory desmitis/desmopathy (12.3%), stifle pathologies (6.5%), cervical vertebrae pathologies (3.1%), arthritis in thoracic vertebrae (1.9%), navicular disease (1.2%), fetlock arthritis (1.2%), coffin joint arthritis (0.8%) and lumbar spondylosis (0.8%).

Relationship between pathology and treatment choices

The variables of number of affected vertebrae, region(s) of the spine affected, and whether the horse had an additional pathology were analysed for association with the three most common treatment types, corticosteroids, physiotherapy, and surgical intervention.

Horses with more affected vertebrae had significantly lower odds of being treated with corticosteroids (OR= 0.82, CI:0.71-0.94, P=0.006), but there was no association between area of the spine affected and corticosteroid use (P=0.093). Horses with another musculoskeletal condition had significantly greater odds of being treated with corticosteroids (OR=1.87 CI: 1.11-3.15, P=0.019). There was no association between number of affected vertebrae (P=0.414) or area of the spine affected (P=0.395) and the inclusion of physiotherapy within the treatment strategy, but horses with another musculoskeletal condition had greater odds of receiving physiotherapy that those without (OR=1.75, CI:1.02-2.92, P=0.032).

Horses with more affected vertebrae had greater odds of being treated surgically (OR= 1.16 CI: 1.01-1.33, P=0.038). Area of the spine affected was also significantly associated with selection of surgery (P=0.037). Horses with pathology in the caudal thoracic region (T10-T18) had five times the odds of undergoing surgery when compared to those with pathology in the lumbar region only (OR= 5.25, CI: 1.45-18.87, P=0.011). There was no association between the presence of an additional condition and the inclusion of surgery in the treatment plan (P=0.795).

[Figure 2 near here]

Relationship between pathology and return to work

There was no significant association between affected region of the spine (P=0.658) or the number of affected vertebrae (P=0.847) and the odds of the horse returning to its previous level of work. Horses with additional pathologies had significantly lower odds of returning to their previous level than those without (OR=0.5 CI: 0.3-0.9, *P*= 0.013), with only 43.7% of horses who had an additional pathology returning to their previous level, compared to 58.8% of horses with no additional pathology.

Relationship between treatment choices and return to work

As the majority of horses were reported as receiving multiple treatment types, all treatments were included as covariates within the regression model to adjust for effects of treatment combinations. Horses treated surgically had significantly greater odds of returning to their previous level of work than those that were not, and horses that underwent a tailored exercise

rehabilitation plan also had significantly greater odds of returning to their previous level of work. None of the other treatment types had a significant association with return to work. The full analysis can be seen in Table 1.

[Table 1 near here]

It was common for treatment approaches to be used in combination with one another. Table 2 shows the number of horses which were reported as receiving each of the possible combinations of the three most common treatments, surgery, corticosteroids, and physiotherapy, and the proportion of these groups which successfully returned to the previous level of work. These data align with the statistical analysis, in that treatment approaches which included surgery showed a greater return to work rate on average.

[Table 2 near here]

Discussion

This cross-sectional study aimed to assess the impact of treatment choices on the long-term prognosis for ridden horses with IDSP. The study used an owner survey to follow up on horses that had been diagnosed and treated at any point in their time with the current owner. The results are encouraging, with 49.6% of horses returning to their previous level of performance after treatment.

Pathology and treatment choice

Horses with higher numbers of affected vertebrae, and particularly those with pathology in the area under the saddle had greater odds of being treated surgically, whereas horses with smaller numbers of affected vertebrae had greater odds of being treated with corticosteroids, which agrees with Coomer *et al.* (2012) and may indicate a preference to treat these horses more conservatively, at least in the first instance.

Horses that were also diagnosed with another musculoskeletal pathology were treated more readily with corticosteroids and had a higher rate of referral to physiotherapy. On first impressions this may appear as a tendency to treat these horses more conservatively, however there was no significant difference in the proportion of horses that were treated surgically between the group with additional pathology and the group without. It is likely that these horses were simply provided with more support, in the form of combination treatment approaches, to try and overcome multiple musculoskeletal pathologies. Recent studies have investigated clinical reasoning within physiotherapists involved in rehabilitating horses after ISLD (Sayers and Tabor, 2020), but aside from justification of case selection within controlled trials (Coomer *et al*., 2012) there have been no widespread studies of veterinarians' clinical reasoning in primary treatment selection for IDSP. This could be a valuable area for future research.

Pathology and return to work

The area of the spine affected or number of affected vertebrae did not appear to have a significant impact on this return to work. This agrees with Walmsley *et al*. (2002) who found no association between number of spinous processes resected and return to work in horses treated surgically. In the current study, horses that had additional pathologies alongside IDSP

had lower odds of returning to their previous level than those that did not, so the potential confounding effect of this needs to be considered when interpreting the findings.

Treatment choice and return to work

Two of the most common treatments were corticosteroids and surgery, which is in agreement with previous studies (Coomer *et al*., 2012; Findley and Singer, 2016; Riccio et al., 2018). As this study was based on an owner survey, specific surgical interventions could not be identified, therefore all surgeries were analysed as one group. Horses that underwent surgery had twice the odds of successfully returning to their previous level than those that did not have surgery. This is consistent with previous studies demonstrating a return to work for the majority of horses post-surgery (Walmsley *et al*., 2002; Coomer et al., 2012; Brink, 2014; Prisk and Garcia-Lopez, 2019).

Corticosteroids are recommended as a treatment option for IDSP (Byron, 2007; Findley and Singer, 2016), and are widely used (Riccio et al., 2018), but did not show a significant association with return to work in this study. Intra-articular use of corticosteroids is well studied and well supported (Boorman et al., 2022; McIlwraith, 2010), but the efficacy of this treatment option for IDSP has not been as thoroughly investigated. Pettersson et al. (1987) compared surgical and conservative approaches and showed a 72% success rate with surgery compared to 23% for conservative management. However, the details on what constituted conservative management were minimal and included rest, massage, pain relieving drugs and exercise, so the sole effects of corticosteroids cannot be isolated. Coomer et al. (2012) compared the long-term effects of surgical treatment (ISLD) and corticosteroids, and found that back pain reoccurred in 56% of the corticosteroid group within the follow up period, and none of the surgical group. The current study agrees with these previous findings and indicates that surgical

245 interventions offer a more promising long-term prognosis for the ridden horse than more
246 conservative treatment plans. This is especially encouraging considering that these horses had
247 greater odds of having pathology in the saddle area.

248 Physiotherapy was one of the most used interventions but did not show any significant
249 association with return to previous level of performance. Both corticosteroids and
250 physiotherapy were used in a higher proportion of those horses that had additional
251 musculoskeletal pathologies, and these horses had significantly lower odds of a promising
252 long-term outcome, which could skew the results for these treatments. Ten different additional
253 pathologies were identified in this study and are all likely to influence the treatment approach
254 in different ways. Future studies would need to explore treatment decisions and outcomes for
255 a greater number of horses diagnosed with IDSP and concurrent musculoskeletal pathologies
256 to provide the statistical power to assess the influence of common comorbidities.

257

258 Within the analysis physiotherapy was a pre-existing category, but one of the new categories
259 created from the 'write-in' answers was exercise rehabilitation. These were horses where the
260 owners described a tailored exercise plan. This group had 10 times the odds of returning to
261 their previous level of work than those horses that were not reported as having a modified
262 exercise programme. Ridden work is a contributing factor to IDSP development and associated
263 pain (Clayton and Stubbs, 2016) and modified exercise is considered an essential component
264 of IDSP treatment (Coomer *et al*., 2012). Multiple meta-analyses of human research identify
265 exercise therapy as the number one primary preventative measure for back pain (Shiri et al.,
266 2018; Steffens et al., 2016; de Campos et al., 2021) and one of the most frequently
267 recommended strategies for management of existing chronic back pain (Qaseem et al., 2017;
268 Oliveira et al., 2018; Stochkendahl et al., 2018). Turner (2011) found that a combination

treatment of mesotherapy, ESWT, and exercise was more effective for treating IDSP than mesotherapy only, or corticosteroid treatment only. Exercise therapy has long been discussed for equine back conditions (Bromiley, 1999) and provided there are no contraindications, it is reasonable to promote tailored exercise programmes for horses with IDSP. Current thinking is that this should focus on strengthening the core musculature to support the spine more effectively (Clayton, 2016; Findley and Singer, 2016). This can include work without the weight of a rider (de Cocq et al., 2004), work over raised poles (Oliveira et al., 2015; Brown et al., 2019), and treadmill work, including water treadmill (Nankervis et al. 2017). There are very few randomised controlled trials within equine exercise rehabilitation (Atalaia, 2021); this is an area that would benefit from further research to provide definitive recommendations for IDSP rehabilitation.

Physiotherapy can encompass a range of different approaches, including electrotherapies, thermotherapy, manual therapy, and exercise prescription (McGowan *et al*., 2007). As this was an owner survey, full details on interventions used could not be obtained, so all physiotherapy treatments were analysed as one group. It could be that some of the horses included in the physiotherapy category should have also been in the 'exercise' group, but owners may not have seen it necessary to make this distinction. Future studies could aim to separate different physiotherapy treatment modalities to gain more insight into specific approaches and treatment combinations which may be of greater benefit.

Limitations

The major limitation of this study is that it was an owner survey, and as such relied on horse owners volunteering for the study and being able to provide accurate details of their horse's

condition. Gathering information from owners gives the advantage of allowing inclusion of a greater range of treatment and rehabilitation approaches and over an extended time frame compared to clinical studies. However, asking horse owners to provide detail of treatments which may have taken place several years prior increases the risk of recall bias (Fenner *et al*., 2020) and there were several areas where more specific details would benefit the analysis, such as grading of IDSP severity, surgical approach used, or therapeutic modalities included in rehabilitation. The survey was distributed via Facebook, meaning that participants were free to self-select whether they took part after seeing the survey being posted. This self-selection can introduce bias, as survey respondents may be more motivated than average to engage with this particular research topic (Bethlehem, 2010) and the vast majority of Facebook users are under 45 years of age (Statista, 2024) which may not be representative of the wider horse owning population. Future studies could use a probability sampling technique and combine both veterinary records and owner follow up to give a more comprehensive picture.

Conclusions

Surgical options were associated with a better long-term prognosis for horses with IDSP than non-surgical treatment plans. If the aim is for the horse to return to a competitive career post-treatment, the most appropriate surgical intervention appears to be the best approach and exercise rehabilitation plans could be of value. The industry may benefit from greater evidence of the particular exercises effective for aiding in spinal pathology rehabilitation, along with exploration of the effect of specific comorbidities on treatment selection and outcomes, to further inform the management of horses with IDSP.

References

Atalaia, Tiago, José Prazeres, João Abrantes, and Hilary M. Clayton. 2021. Equine Rehabilitation: A Scoping Review of the Literature. Animals 11, no. 6: 1508.

Bethlehem, J., 2010. Selection bias in web surveys. International statistical review, 78(2), pp.161-188.

Boorman, S., McMaster, M.A., Groover, E. and Caldwell, F., 2022. Review of glucocorticoid therapy in horses: Intra-articular corticosteroids. Equine Vet Educ.

Brink, P., 2014. Subtotal ostectomy of impinging dorsal spinous processes in 23 standing horses. Vet Surg, 43(1), pp.95-98.

Bromiley, M.W., 1999. Physical therapy for the equine back. Vet Clin North Am Equine Pract, 15(1), pp.223-246.

Brown, S., Tabor, G. and Williams, J., 2019. The effect of trot pole exercise on rectus abdominus activity in the horse. J Vet Behav, 29, p.155.

Byron, C.R., 2007. Glucocorticoids in the Management of Equine Back Pain. Compendium Equine, pp.260-265.

de Campos, T.F., Maher, C.G., Fuller, J.T., Steffens, D., Attwell, S. and Hancock, M.J., 2021. Prevention strategies to reduce future impact of low back pain: a systematic review and meta-analysis. Br J Sports Med, *55*(9), pp.468-476.

Clayton HM. Core Training and Rehabilitation in Horses. Vet Clin North Am Equine Pract. 2016 Apr;32(1):49-71. doi: 10.1016/j.cveq.2015.12.009. PMID: 27012507.

Clayton, H.M. and Stubbs, N.C., 2016. Enthesophytosis and impingement of the dorsal spinous processes in the equine thoracolumbar spine. J Equine Vet Sci, 47, pp.9-15.

de Cocq, P.D., Van Weeren, P.R. and Back, W., 2004. Effects of girth, saddle and weight on movements of the horse. Equine Vet J, 36(8), pp.758-763.

Coomer, R.P., McKane, S.A., Smith, N. and Vandeweerd, J.M.E., 2012. A controlled study evaluating a novel surgical treatment for kissing spines in standing sedated horses. Vet Surg, 41(7), pp.890-897.

Dyson, S. and Ross, M., 2011. Diagnosis and Management of Lameness in the Horse. St. Louis, Mo: Elsevier/ Saunders.

Erichsen, C., Eksell, P., Holm, K/R., Lord, P. and Johnston, C., 2004. Relationship between scintigraphic and radiographic evaluations of spinous processes in the thoracolumbar spine in riding horses without clinical signs of back problems. Equine Vet J, 36(6). Pp. 458-465.

Fenner, K., Hyde, M., Crean, A. and McGreevy, P., 2020. Identifying sources of potential bias when using online survey data to explore horse training, management, and behaviour: A systematic literature review. Veterinary Sciences, 7(3), p.140.

Findley, J. and Singer, E., 2015. Equine back disorders 1. Clinical presentation, investigation and diagnosis. In Practice, 37(9), pp.456-467.

Findley, J. and Singer, E., 2016. Equine back disorders 2. Treatment options. In Practice, 38(1), pp.33-38

Fiske-Jackson, A., 2018. Diagnosis and management of impinging spinous processes. UK-Vet Equine, 2(1), pp.15-21.

Henson, F.M.D., 2017. Pathology of the thoracic dorsal spinous processes. Equine Vet Educ, 31(1), pp.34-36.

Jacklin, B., Minshall, G. and Wright, I., 2014. A new technique for subtotal (cranial wedge) ostectomy in the treatment of impinging/ overriding spinous processes: Description of technique and outcome of 25 cases. Equine Vet J 46(3), pp. 339-344.

Jeffcott, L.B., 1979. Radiographic features of the normal equine thoracolumbar spine. Vet Radiology, 20(3-6), pp.140-147.

McGowan, C.M., Stubbs, N.C. and Jull, G.A., 2007. Equine physiotherapy: a comparative view of the science underlying the profession. Equine Vet J, 39(1), pp.90-94.

McIlwraith, C.W., 2010. The use of intra-articular corticosteroids in the horse: what is known on a scientific basis?. Equine Vet J, 42(6), pp.563-571.

Nankervis, K.J., Launder, E.J. and Murray, R.C., 2017. The use of treadmills within the rehabilitation of horses. J Equine Vet Sci, 53, pp.108-115.

de Oliveira, K., Soutello, R.V., da Fonseca, R., Costa, C., Paulo, R.D.L., Fachiolli, D.F. and Clayton, H.M., 2015. Gymnastic training and dynamic mobilization exercises improve stride quality and increase epaxial muscle size in therapy horses. J Equine Vet Sci, 35(11-12), pp.888-893.

Oliveira, C.B., Maher, C.G., Pinto, R.Z., Traeger, A.C., Lin, C.W.C., Chenot, J.F., van Tulder, M. and Koes, B.W., 2018. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. Eur Spine J, 27, pp.2791-2803.

Pettersson, H., Strömberg, B. and Myrin, I., 1987. Das thorkolumbale, interspinale Syndrom (TLI) des Reitpferdes-Retriospektiver Vergleich konservativ und chirurgisch behandelter Fälle. Pferdeheilkunde, 3, pp.313-319.

Prisk, A.J. and García-López, J.M., 2019. Long-term prognosis for return to athletic function after interspinous ligament desmotomy for treatment of impinging and overriding dorsal spinous processes in horses: 71 cases (2012–2017). Vet Surg, 48(7), pp.1278-1286.

Qaseem, A., Wilt, T.J., McLean, R.M., Forciea, M.A. and Clinical Guidelines Committee of the American College of Physicians*, 2017. Noninvasive treatments for acute, subacute, and chronic low back pain: a clinical practice guideline from the American College of Physicians. Ann Intern Med Clin Cases, 166(7), pp.514-530.

Rahman Shiri, David Coggon, Kobra Falah-Hassani, Exercise for the Prevention of Low Back Pain: Systematic Review and Meta-Analysis of Controlled Trials, Am J Epidemiol, Volume 187, Issue 5, May 2018, Pages 1093–1101, https://doi.org/10.1093/aje/kwx337

Riccio, B., Fraschetto, C., Villanueva, J., Cantatore, F. and Bertuglia, A., 2018. Two multicenter surveys on equine back-pain 10 years a part. Front Vet Sci, 5, p.195.

Sayers, E. and Tabor, G., 2020. An exploration of clinical reasoning and practices used by physiotherapists in the rehabilitation of horses following interspinous ligament desmotomy surgery. Physiotherapy Theory and Practice, 38(7), pp.897-907.

Shiri, R., Coggon, D. and Falah-Hassani, K., 2018. Exercise for the prevention of low back pain: systematic review and meta-analysis of controlled trials. Am J Epidemiol, 187(5), pp.1093-1101.

Sinding, M.F. and Berg, L.C., 2010. Distances between thoracic spinous processes in Warmblood foals: a radiographic study. Equine Vet J, 42(6), pp.500-503.

Statista, 2024. Distribution of Facebook users worldwide as of April 2024, by age and gender. https://www.statista.com/statistics/376128/facebook-global-user-age-distribution/. Accessed on 30/06/2024.

Steffens, D., Maher, C.G., Pereira, L.S., Stevens, M.L., Oliveira, V.C., Chapple, M., Teixeira-Salmela, L.F. and Hancock, M.J., 2016. Prevention of low back pain: a systematic review and meta-analysis. JAMA Intern Med, *176*(2), pp.199-208.

Stochkendahl, M.J., Kjaer, P., Hartvigsen, J. *et al.* National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. Eur Spine J **27**, 60–75 (2018).

Stubbs, N.C., Hodges, P.W., Jeffcott, L.B., Cowin, G., Hodgson, D.R. and McGowan, C.M., 2006. Functional anatomy of the caudal thoracolumbar and lumbosacral spine in the horse. Equine Vet J, 36, pp.393-399.

Stubbs, N.C., 2011. Epaxial musculature, motor control and its relationship with back pain in the horse: objective clinical physical therapy, pathological and imaging studies. In Proceedings of the 57th Annual Convention of the American Association of Equine Practitioners, San Antonio, Texas, USA, 18-22 November, pp. 153-157.

Turner, T.A., 2011. Overriding spinous processes (" kissing spines") in horses: diagnosis, treatment, and outcome in 212 cases. In Proceedings of the 57th Annual Convention of the American Association of Equine Practitioners, San Antonio, Texas, USA, 18-22 November 2011 pp. 424-430.

Walmsley, J.P., Pettersson, H., Winberg, F. and McEvoy, F., 2002. Impingement of the dorsal spinous processes in two hundred and fifteen horses: case selection, surgical technique and results. Equine Vet J, 34(1), pp.23-28.

Zimmerman, M., Dyson, S. and Murray, R., 2012. Close, impinging and overriding spinous processes in the thoracolumbar spine: the relationship between radiological and scintigraphic findings and clinical signs. Equine Vet J, 44(2), pp. 178-184.

Table 1

Associations between inclusion of a treatment within the overall treatment strategy and odds of returning to the previous level of performance in a sample of 260 horses with IDSP

Table 2

Proportion of horses returning to the previous level of performance for each of the main treatment combinations used in a sample of 260 horses with IDSP

435 **Figure 1**

436 The proportion of 260 horses with IDSP that received the different treatment types

437

438 **Figure 2**

439 The proportion of 260 horses with IDSP treated with corticosteroids or surgery, by number of

440 affected vertebral processes