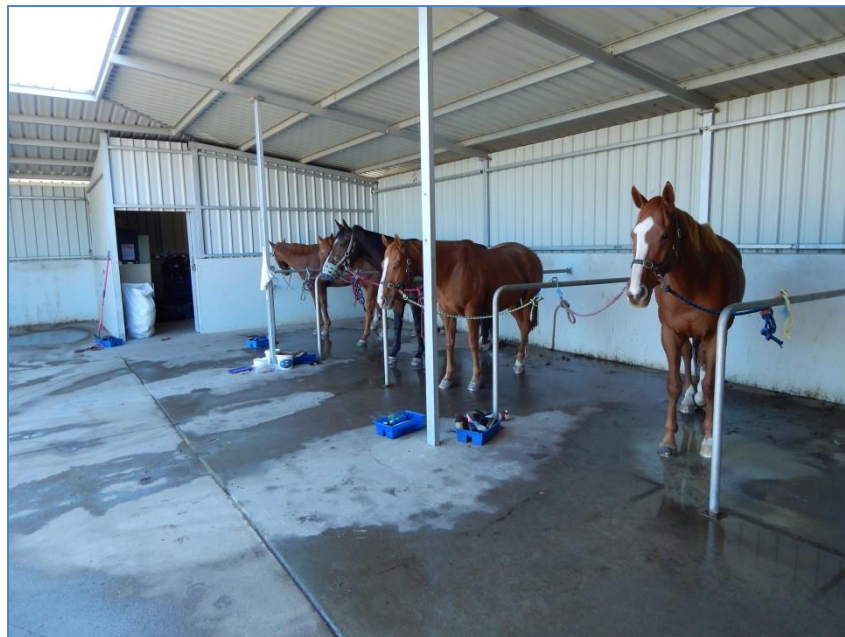


THE EFFECT OF FARRIERY ON DORSAL HOOF WALL RENEWAL IN THOROUGHBRED GELDINGS IN A LEARNING ENVIRONMENT



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Introduction

Horses have been part of the Australian thoroughbred industry since colonisation. They have the ability to move quickly across terrain, sustaining this ability almost indefinitely with good husbandry. One of the fundamentals that allows this to happen is the foot, commonly known as the hoof. Hooves constantly grow and rejuvenate while wearing away at the same time. If the horse is worked beyond its limits the hoof cannot sustain the wear pattern, and hoof protection is required in the form of horseshoes. The fitting of horseshoes and hoof care is a skilled profession known as farriery.

The rate at which the hoof rejuvenates has been reported that, hoof wall renews in the mature horse from every nine to twelve months. Hood and Larsen (2013) state, 'it takes about six to nine months for the entire hoof wall to be replaced'.

Hoof wall renewal time in thoroughbred geldings is poorly reported. This study recorded the effect of farriery on dorsal hoof wall renewal in thoroughbred geldings in a learning environment. The procedure followed previous studies while incorporating modern materials, and technology to assist data collection.

Reference indicators were placed in front feet dorsal hoof wall distal to the hair line coronary band in thoroughbred geldings 5 to 17 years of age when studied. Ethical approval was granted by the Melbourne Polytechnic animal ethics projects committee.

Horses used in this farrier college environment are subjected to hoof care and farrier intervention performed with a range of ability and skill. The results revealed that farriery practices alone do not have an effect on hoof wall renewal. The study revealed hoof wall renewal can become inconsistent due to work load.

Literature review

Hoof wall renewal is general in context as the hoof consist of multiple horn structures that exhibit different qualities. For example; the solar surface of the hoof exfoliates leaving it near impossible to measure. The outer hoof wall which bears most of the weight when the horse moves attracts the most research. Kainer and Fails (2011) state, 'the growth of the hoof wall progresses at the rate of approximately 6mm per month taking from 9 to 12 months for the toe to grow out'.

The horse's gender is said to have an effect on hoof renewal. Lungwitz (1966.) states, 'the average monthly growth in both shod and unshod horses of both sexes is one third of an inch. Hind feet growth faster that front hoofs, stallion's growth faster that mares and geldings'.

Recent studies have set out to define and establish the hoof wall renewal time in thoroughbred foals. Curtis, Martin and Hobbs (2014) stated thoroughbred foals replace the fetal hoof in approximately half the time taken for mature horses (270 -365 days) giving a range of 120 - 165 days for the fetal hoof to be removed by trimming.

The growth of the equine hoof wall and its consistency may be affected by the environment and climatic conditions in which horses are agisted at livery. Kainer, Fails (2011) state, 'the wall grows more slowly in a cold environment. Growth is also slower in a dry environment'.

The movement of the horse combined with good farriery may assist with hoof wall renewal. Dollar and Wheatley (1898) state, 'in horses which are shod, growth is favored by free movement on moderate to soft ground by careful shoeing which provides for expansion of the foot. Growth is favored by the horse going barefoot'.

The previous research and analysis were revealed to be correct in the context of general equine husbandry. Gaps in the aforementioned research can be summarised as follows:

- Lack of detail in reference to method and delivery
- Lack of detail in types of horseshoes/trimming
- Nonspecific breeds of equine (Curtis, Martin and Hobbs being the exception)

Materials and Method

Front hooves of 14 thoroughbred geldings were studied. Nine horses were studied for more than 12 months. Five horses were studied in less than 12 months. Front feet were referenced, left and right alternately on each horse to enable the opposite front foot to act as a control.

Occupation health and safety (OH&S) and animal welfare were paramount when collecting data, horse holder/spotters assisted throughout the study. Sedation was not required to be administered to the horses.

The study was conducted at the Epping Campus, Melbourne, and Eden Park campus, 45 km north of Melbourne in the state of Victoria, Australia. The climate over the period of study as recorded by the Australian Bureau of Meteorology was 'Temperatures above average, and rainfall very much below average' (Commonwealth of Australia 2016).

Pilot studies were performed prior to the commencement of the study on cadaver equine hoof specimens. Veterinary and equine teaching staff consultation ascertained the safest and most sustainable method of reference marking within ethical boundaries.

Equipment

A digital camera, 16.4 mega pixel auto focus with macro enabled, anti-shake, full frame viewing panel was used to record visual data.



Figure 1: Marking equipment and PPE. A. Gloves B. Dust mask C. Eye protection D. Mixing pallet and spatula E. Acrylic hoof rebuild compound (glue) F. Battery operated hand held drill and bit

Figure 1 shows marking equipment used to create reference marks.

Figure 2 shows measuring and recording equipment.

Standard farrier operating procedures performed were:

- Foot dressing
- Making, fitting, nailing and gluing horseshoes
- Finishing the horseshoeing process
- Trimming the feet for summer turn



Figure 2: Measuring and recording equipment. A. Large Compass B. Engineers ruler C. Fine line marker pen D. Regular marker pen E. 8 mm Sticker disc F. Small compass

Procedure A (marking)

A battery operated drill with a 2 mm drill bit was used, set with a back stop to a depth of 5 mm (Figure 3). Five millimeter depth was achieved by inserting the cutting bit into the chuck until it stopped at the base of the internal chuck grinding the base of the protruding drill bit (shank) leaving 5 mm from the chuck jaws. The bit was turned around to normal positioning with the shank inserted all the way to the base of the chuck, leaving a 5 mm cutting bit protruding. This was important to ensure that the drill bit, did not exceed the safe permissible depth of 5 mm ensuring the sensitive lamina was not pierced.

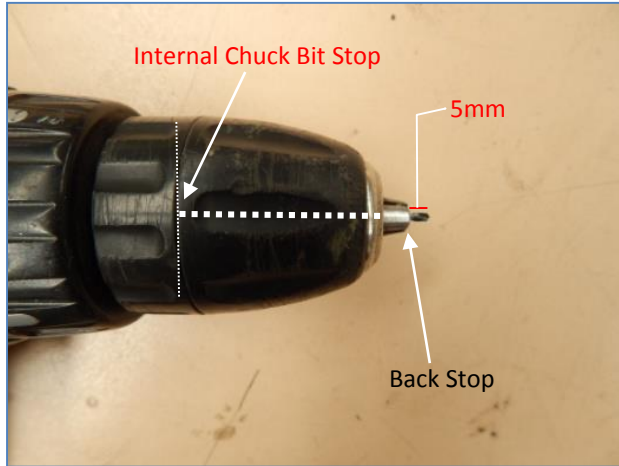


Figure 3: Drill chuck bit depth

An orifice was made in the dorsal hoof wall 2 mm in diameter, 5 mm in depth placed 15 mm distal from the periople hair line (Figure 4)

The orifice was filled with acrylic hoof rebuild compound, allowed to set and filed smooth creating a plug reference mark. Fine line marking was applied to the periople hair line, and the hoof numbered for cataloging. An eight millimetre calibration disc was applied to the hoof (Figure 5). The mark was estimated to last the full hoof wall renewal cycle until it could be removed by farrier intervention or worn away.



Figure 4: Reference mark 15mm distal to hair line



Figure 5: Small compass measuring distance from periople hair line to reference mark Yellow calibration disc is shown

Procedure B (maintenance)

Refer to Table 1.

Measuring procedure

Small compass measurements were taken from the dorsal periople hairline to the center of the reference mark (Figure 5). The measurement was checked using a ruler then recorded onto Table 1. Fifteen millimeters were deducted from the distance the reference mark had moved from the periople hairline, recording the actual toe growth (Table 1 Observations, Notes).



Figure 6: Measuring dorsal toe length

A large compass was used to record the dorsal toe length (Figure 6). Journal log entries included farrier procedures performed on each individual horse (Table 1).

The compass was laid flat when recording measurements as opposed to right angles to reduce the risk of injury.

Hoof growth was studied when farrier training was delivered to students further data were also recorded when the horses were used for student track rider training. Frequency of recording the data was not the same for every horse; it ranged from six to seven recordings in 203 to 244 days, to ten to thirteen in 365 to 392 days. The time frame between recordings ranged from six days to 112 days, the latter due to horses spelling over summer months

Visual recording procedure



Figure 7: Lateral view, anterior 90° camera angle, glued race plate, pilot study

Visual data assisted with verification and validation of the study, camera shots taken at 90° to the dorsal hoof wall gave the optimal recording (Figure 7). Parallax error occurred when the camera was not at 90° to the dorsal hoof wall.

Figure 8 shows the hoof framed centre to show the craniocaudal view.

The raw data were recorded into a table, for an example refer Table 1, and then transferred into an excel spreadsheet for further analysis.

Farrier procedures

All horses had shoes fitted and maintained in all 4 feet. The shoes were removed, end of the 2nd semester and horses turned out over summer (spelled).

Two horses were fitted with shoes nailed on for 244 to 350 days.



Figure 8: Glued race plate craniocaudal view



Figure 9: Race plate nailed on

Five horses were fitted with pairs of aluminum shoes attached to the hooves with acrylic glue (Figures 7 and 8). The shoes were maintained between 33 to 70 days basic riding.

Seven horses were fitted with aluminum shoes nailed on (Figure 9) all 4 feet. Shoes were maintained from 12 to 63 days basic riding.

Five horse were fitted with $\frac{3}{4}$ fullered regular bar shoes in all 4 feet (Figure 10). Maintained on the hoof 14 to 98 days basic riding.

Four horses were fitted with heart bar shoes (Figure 11) in all 4 feet. Shoes stayed on from 42 to 63 days flat work.



Figure 10: Regular bar shoe



Figure 11: Heart Bar shoe

Ten horses were turned out over summer (spelled) between 80 and 112 days. Figure 12 shows shoe taken off and foot dressed. Procedure A was repeated leaving two reference marks (Figure 12) prior to the horses being spelled. This ensured that data was collected as the initial mark would be lost at spelling.

Four horses were omitted from spelling, due to been fostered out to various locations off campus.



Figure 12: Foot dressed Spelling 1st and 2nd reference mark

Procedure A			Procedure B				
Front feet 2mm diameter hole (reference mark) drilled into dorsal hoof wall. Depth 5mm, 15mm distal from the periople hair line center mid line. Hole filled with acrylic hoof rebuild compound Applied 8 mm disc sticker for calibration Text pen horse identification number applied. Photograph and record data.			Front feet 2mm diameter hole (reference mark), dorsal hoof wall inspected and maintained. Holes filled with acrylic hoof rebuild compound if required Applied 8 mm disc sticker for calibration Text pen horse identification number applied. Photograph and record visual data				
Farrier procedures applied to horses and acronyms. Nailed (N) Glued (G) No shoes (NS) Near fore (NF Left) Off fore (OF Right) Race plates (RP) Steel Shoes(SS) Regular Bar shoe (RBS) Heart bar shoe (HBS) Toe Length (TL) Spelling trim (SP)							
Horse Number	Age @01/08/14	Brand ID	Gelding/ Mare	Foot	Procedure Farrier procedures	Date	Observations Notes
1	7	61 7	G	NF Left	A RP N	19/03/15	
1	7	61 7	G	NF Left	B RP N	31/03/15	
3	11	56 3	G	OF Right	A RP N	12/03/15	
3	11	56 3	G	OF Right	B RP N	19/03/15	
6	9	57 5	G	NF Left	B SS N	20/08/15	

Table 1: Method example, field recording data

Results

The following tables and graphs were compiled using raw data to cluster groups of horses. The values presented were rounded to two significant figures.

Table 2 summarises the results. Annualised toe growth was calculated as follows;

$$\text{Annualised toe growth} = \frac{\text{actual toe growth during study (mm)}}{\text{duration of study (days)}} \times 365$$

Horse	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Days Studied	371	281	362	364	203	364	371	244	392	244	371	364	371	350
Total growth (mm)	86	55	103	90	49	89	76	49	81	51	98	81	91	96
Average growth per day (mm)	0.23	0.20	0.28	0.25	0.24	0.24	0.20	0.20	0.21	0.21	0.26	0.22	0.25	0.27
Average toe length (TL) during study (mm)	89	86	93	91	95	91	94	89	86	88	98	87	91	92
Annualised toe growth (mm/a)	85	71	104	90	88	89	75	73	75	76	96	81	90	100

Table 2: Horses studied, toe growth and average rate of toe growth

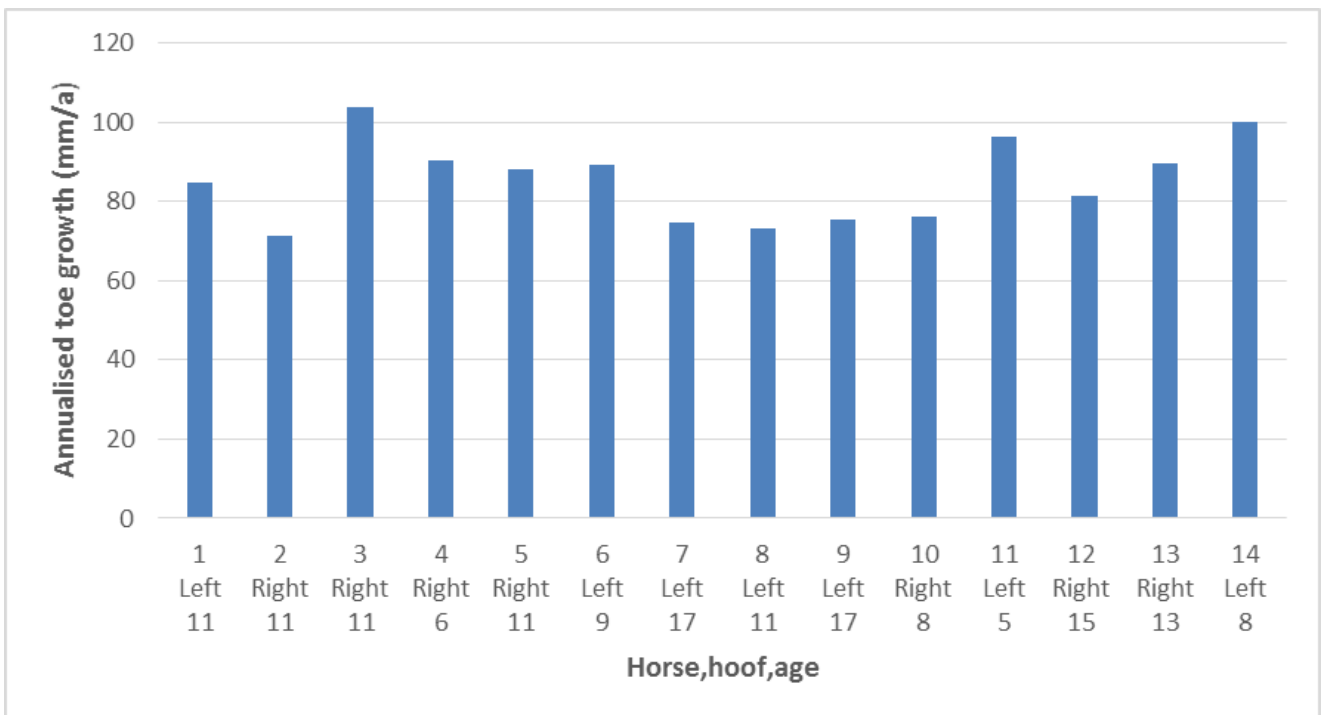


Figure 13: Annualised toe growth of fourteen thoroughbred geldings

Figure 13 shows annualised toe growth results for each horse. Summary of activity relevant to each horse:

1. Moderate work
2. Horse started work late into study
3. Most hoof growth recorded, moderate work
4. Performs high work load, age 6
5. Performs high work load, age 11
6. Unexpected growth, horse does not get worked, age 9
7. Poor growth, light work, age 17
8. Horse started work late into study
9. Poor growth, light work, age 17
10. Not worked age 8
11. Performs high work, age 5
12. Performs high work 15
13. Performs high work, age 13
14. Performs high work, age 8

Figure 14 the effect of farriery procedures and horse work on toe growth. The farrier procedures results were unexpected as they did not reflect any significant changes in hoof growth.

Hoof wall renewal was annualised in each group:

- Glued shoes - 74.92
 - Nailed shoes - 74.37
 - Regular bar shoes - 75.38
 - Heart Bar shoes - 74.59
 - Spelling barefoot - 123.74
 - Basic Riding - 71.85
 - Flat work - 69.70
 - Track Work - 81.29
- } Mean average 75 mm Unexpected
- Expected
- } Mean average 74 mm

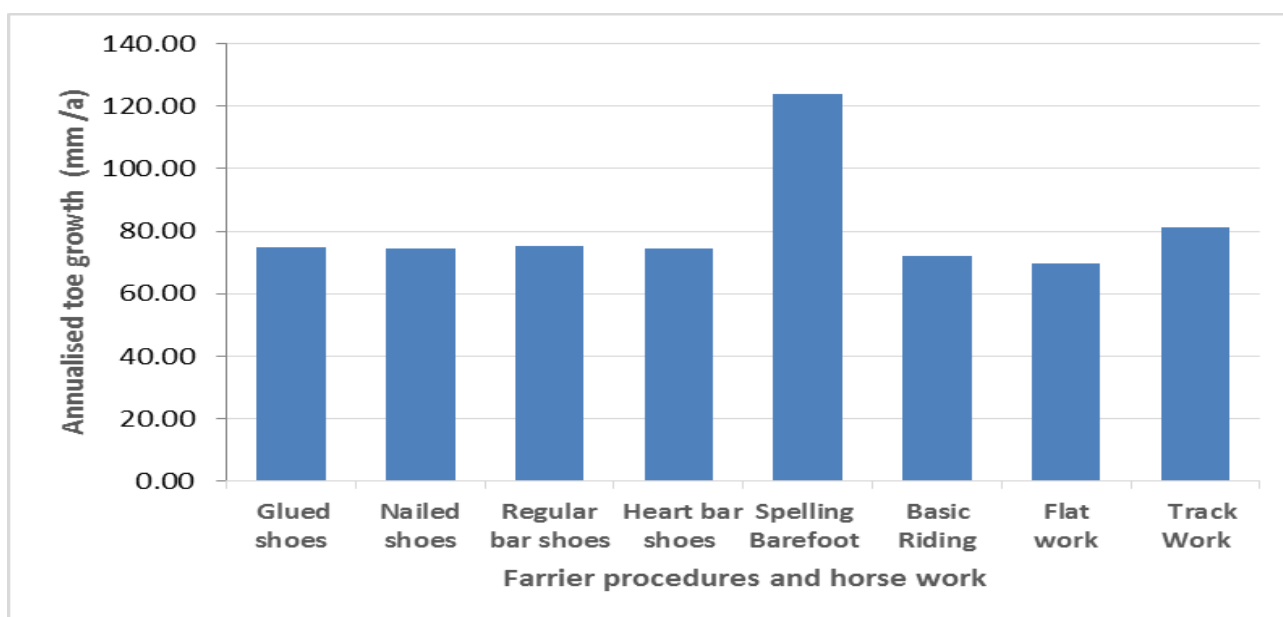


Figure 14: Effect of farrier procedures and horse work on toe growth

Table 3 shows the average toe length being maintained by naturally wearing away, this was established by the corresponding highlighted data in the table.

Horse Hoof Front Age	1 Left 7	3 Right 11	6 Left 9	4 Right 6	7 Left 17	9 Left 17	11 Left 5	12 Right 15	13 Right 13	14 Left 8
Days spelled	108	94	80	83	112	111	111	84	112	83
Spelling trim toe length (mm)	82	91	83	81	86	79	89	84	81	85
Toe length post spelling	88	92	92	89	94	86	92	89	90	88
Average toe length during study (mm/a)	89	93	91	91	94	86	98	87	91	92
Hoof Wall renewal wear pattern (mm)	34	33	26	28	30	31	35	28	38	49

Table 3: Effect of spelling on toe length wear pattern

Figure 15 shows the cumulative growth in mm of all the horses over the duration of the study. The patterns indicate that hoof growth is not consistent over a twelve month period. Not all lines follow a straight path from the start to the end of the study, deviations were mapped back to work load and rest.

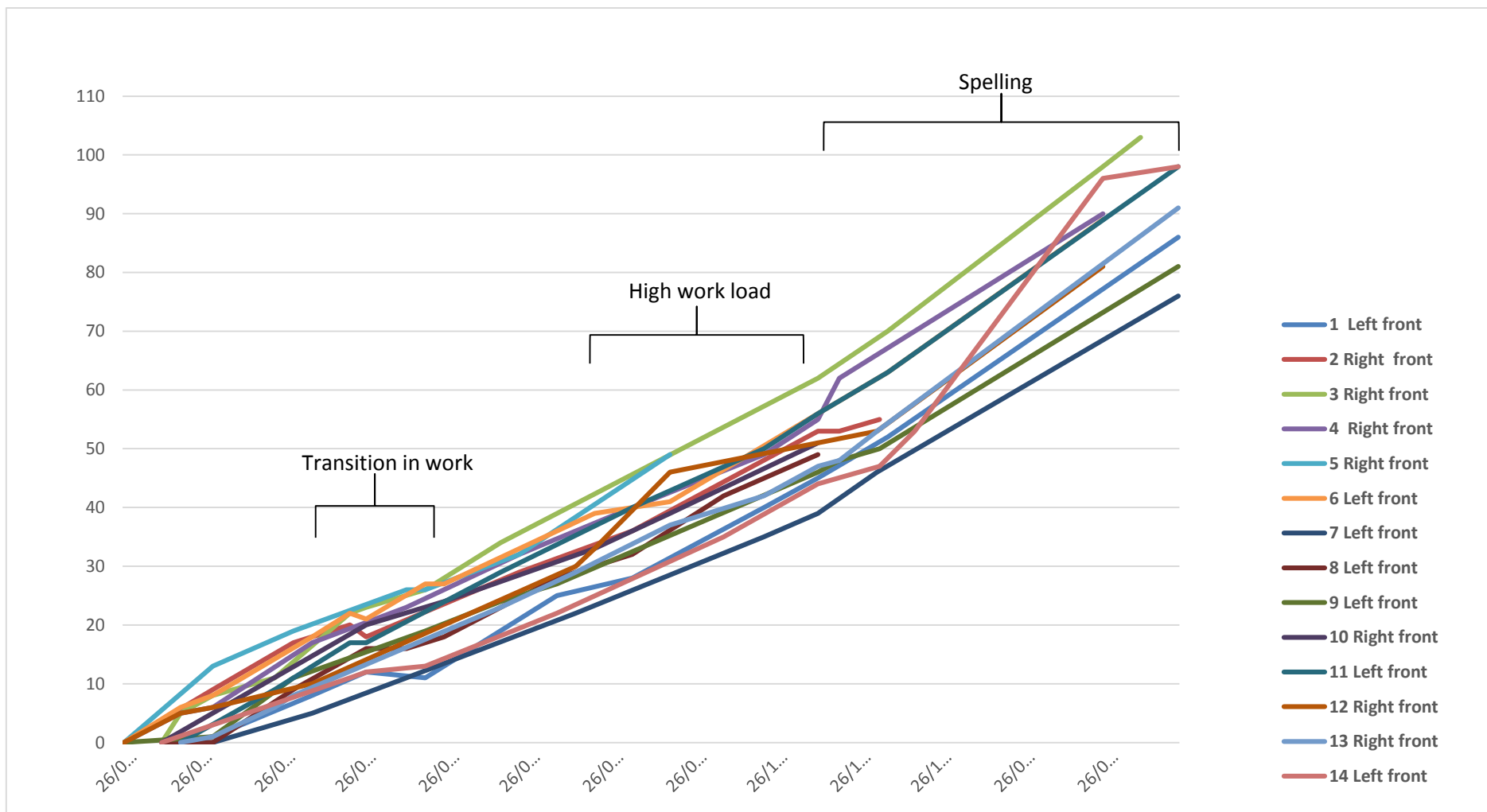


Figure 15: Cumulative toe growth of all horses over the duration of the study

Discussion

What defines this study from previous research is the narrow scope focusing of fourteen thoroughbred geldings in a given set of circumstances. The comparisons made between farrier procedures using modern materials i.e. glue shoes and traditional handmade bar shoes.

Results showed that horses at spelling, hooves grew faster when horses were not shod and maintained toe length moving on a firm surface. Increased exercise of horses with shoes and rest periods revealed consistent hoof growth. Horses subject to increased work load and a change in pace transitioning from riding tasks, showed that hoof growth slowed with compression of the hoof wall (keratinisation).



Figure 16: Spelling trim TL 91 mm horse 3

For example: Horse No.3 spelling trim TL 91 (Figure 16), after 80 days spelling TL 92, but growth was 28 mm (Figure 17) i.e. 28 mm was worn away, hoof toe length maintained at 92 mm.

The spelling toe length trim did not always match the mean average toe. The trimming process was achieved by dressing the anterior wall working back to the heel quarters, with little trimming of the solar surface of the hoof to combat the hard terrain and hot climate where ground temperatures can reach over 50 °C.

Horses at spelling revealed an increased growth pattern without extra work load compared to shod feet. Nine out of 10 hooves revealed hoof wear growth patterns mentioned in previous research (Dollar 1898).

Toe length was maintained at the same length \pm 4 mm compared with the mean average toe length of each individual horse (Table 3). At the same time toe growth had increased compared to the shod foot.



Figure 17: 80 days spelling TL 92 mm - growth 28 mm worn away

These results gave a clear understanding of this wear to growth pattern in the unshod hoof. This evidence in future may assist educators to train farrier students to gauge the length of toe and depth of hoof wall to remove in foot preparation classes.

The unexpected result was the use of heart bar shoes which revealed no significant difference with regular horseshoes. The hypothesis that heart bars shoes when fitted will speed up and improve hoof wall renewal time can be questioned. Results from this study, suggest a combination of regular exercise, spelling and good farrier procedure may assist hoof wall renewal time.



Figure 18: Toe growth 7 mm disparity 2mm 1st reference dot lost, track work

Analysis comparing cumulative growth patterns, work load and data revealed horses that performed high workloads showed slow hoof growth towards the end of the 2nd semester. For example 2 mm reduction between the 1st and 2nd reference marks. The 1st reference mark was lost (Figure 18). The hypothesis that compressive force had squeezed the acrylic plug out.

Nearing the end of track riding class, hooves with shoes retained excess horn growth. The combination of a hard distal border on the hoof, descending body weight and working on a hard ground surface has an effect on the quality of hoof wall. This suggests that compression of the hoof wall takes place.

Obvious marks on the hoof wall, for example nail holes and nail ends (clenches) (Figure 19) may be used as reference points. These only serve a certain part of the hoof depending on the positioning. Low marks would be lost due to trimming and shoeing very early in the study (Figure 20).



Figure 19: Hoof displaying old nail holes and clenches



Figure 20: Hoof dressed

Orifices filled with acrylic compound as reference marks for mapping growth rate was the solution. These marks lasted the entire duration of hoof renewal cycle and could be used to measure barefooted horses where nail holes do not exist. (Figure 20).

Induced reference marks that are superficial are soon lost, due to natural hoof wear and farrier intervention. A reference mark formed using a rasp was administered (Figure 21). This demonstrated that superficial marking of the hoof wall cannot be relied on, as this was just visible at 70 days and lost at 126 days into the study.



Figure 21: Submural abscess horizontal crack horse 3

At commencement of the study, horse 3 presented with a previously erupted submural abscess at the coronary band causing a horizontal crack in the hoof wall (Figure 21). The time for the injury to grow out was recorded at 268 days (Figure 16).

Understanding the hoof wall renewal time can assist the veterinarian, farrier and horse owner in making a hoof wall injury prognosis.

A pilot study of the lateral quarter heel region of the hoof was also undertaken at the same time. The pilot revealed that the hoof wall grows equally proximal hair line to distal ground surface from heel to toe parallel to the coronary band.

At the conclusion of data collection the region had sustained very low rain fall cumulating in a drought lasting in excess of ten years. In the summer month's temperatures of 35°C to 40 °C for weeks were not uncommon when farriery and study procedures were administered. By default this narrowed the scope of study. Further study in normal or wet conditions may provide a comparative result.

Conclusion

The main aims of the study were to ascertain the effect of farrier procedures on dorsal hoof renewal and provide a method of obtaining data that could be reproduced and transportable.

The limitation of this study is also its key to success, using the reference mark was outside the realm of standard farrier practice. Reproduction of this study requires a sound knowledge of the hoof capsule with highly developed farrier skills. Simply put, drilling holes in horse's feet without due diligence and approval is not recommended. Raw data (Appendix) proved to be invaluable when submitting horse usage reports to the animal ethics committee.

This study revealed that dorsal hoof wall renewal is more prolific in barefoot front feet verses shod feet in thoroughbred geldings a result of natural wear to growth patterns. Farrier procedures indicated to have no effect on hoof wall renewal.

Fixing horseshoes with glue demonstrated no changes in hoof growth compared with horseshoes nailed to the hoof. The hypothesis that glue shoes hinder the function of the hoof and retard hoof wall renewal. Future direction to ascertain the impact of long term shoeing using glue shoes verses nailed shoes requires further study.

Horses renewed the dorsal hoof wall in a twelve month period. Young horse growth was faster than in the older horse. Hoof wall renewal was more prolific in horses that performed the greatest work load. Hoof wall renewal is a reflex intrinsic synergy, if for any reason it breaks downs poor horn quality and equine performance may be compromised.

This study has provided some dispersion of dogma that horseshoes and barefoot trimming alone does not improve hoof wall renewal, but serves as part of the process of good equine husbandry that can enhance the performance of the equine athlete.

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Appendix: Summary of raw data

Horse work		Basic	Flat	Track											
Number Horse	Age	Sequential record	1	2	3	4	5	6	7	8	9	10	11	12	13
		Date	19/03/2015	31/03/2015	7/05/2015	27/05/2015	18/06/2015	6/08/2015	3/09/2015	22/10/2015	11/11/2015	7/12/2015	24/03/2016		
1. Andy	7	Calender days	0	12	37	20	22	49	28	49	20	26	108		
NF Left front		Cumulative toe growth (mm)	0	1	8	12	11	25	28	40	45	52	86		
		2nd reference										0	34		
		Actual toe growth (mm)	0	1	7	4	-1	14	3	12	5	7	34		
		Shoe type/Trim	RP,N	RP,N	RBS,N	SS,N	SS,N	SS,N	SS,N	SS,N	SS,N	SP	RP,G		
		Toe length at the time of recording (mm)	79	85	90	92	87	96	93	92	87	88	88		
		Toe length after trimming (mm)										82			
		Date	26/02/2015	31/03/2015	30/04/2015	21/05/2015	27/05/2015	23/07/2015	3/09/2015	11/11/2015	19/11/2015	4/12/2015			
2. Archie	11	Calender days	0	33	30	21	6	57	42	69	8	15			
OF Right front		Cumulative toe growth (mm)	0	9	17	20	18	29	36	53	53	55			
		2nd reference									0	4			
		Actual toe growth (mm)	0	9	8	3	-2	11	7	17	0	2			
		Shoe type/Trim	RP,G	RP,G	SS,N	SS,N	SS,N	SS,N	SS,N	SS,N	SS,N	SP			
		Toe length at the time of recording (mm)	84	83	90	86	84	83	86	86	86	88			
		Toe length after trimming (mm)										77			
		Date	12/03/2015	19/03/2015	31/03/2015	23/04/2015	21/05/2015	27/05/2015	18/06/2015	16/07/2015	17/09/2015	11/11/2015	7/12/2015	25/02/2016	10/03/2016
3. Bigity	11	Calender days	0	7	12	23	28	6	22	28	62	54	26	80	14
OF Right front		Cumulative toe growth (mm)	0	5	8	11	22	23	26	34	46	62	70	98	103
		2nd reference										0	28	33	
		Actual toe growth (mm)	0	5	3	3	11	1	3	8	12	16	8	28	5
		Shoe type/Trim	RP,N	RP,N	SS,N	SS,N	SS,N	SS,N	SS,N	RT,SS,N	SS,N	SS,N	SP	NS	SS N
		Toe length at the time of recording (mm)	79	81	90	82	98	91	92	91	91	110	111	92	93
		Toe length after trimming (mm)											91		
		Date	26/02/2015	19/03/2015	31/03/2015	7/05/2015	11/06/2015	23/07/2015	3/09/2015	22/10/2015	11/11/2015	4/12/2015	25/02/2016		
4. Buddy	6	Calender days	0	21	12	37	35	42	42	49	20	23	83		
OF Right front		Cumulative toe growth (mm)	0	5	6	17	23	32	40	49	55	62	90		
		2nd reference										0	28		
		Actual toe growth (mm)	0	5	1	11	6	9	8	9	6	7	28		
		Shoe type/Trim	RP,G	RP,G	NS	RBS,N	HBS,N	SS,N	SS,N	SS,N	SS,N	SP	NS		
		Toe length at the time of recording (mm)	87	93	85	87	90	96	94	94	90	96	89		
		Toe length after trimming (mm)										81			
		Date	26/02/2015	31/03/2015	30/04/2015	11/06/2015	18/06/2015	23/07/2015	17/09/2015						
5. Charlie	11	Calender days	0	33	30	42	7	35	56						
OF Right front		Cumulative toe growth (mm)	0	13	19	26	26	32	49						
		2nd reference													
		Actual toe growth (mm)	0	13	6	7	0	6	17						
		Shoe type/Trim	RP,N	RP,N	RP,N	HBS,N	HBS,N	SS,N	SS,N						
		Toe length at the time of recording (mm)	83	92	100	99	90	92	106						

	Date	26/02/2015	19/03/2015	31/03/2015	7/05/2015	21/05/2015	27/05/2015	25/06/2015	20/08/2015	17/09/2015	11/11/2015	7/12/2015	25/02/2016	
6. Cookie (not worked)	9	Calender days	0	21	12	37	14	6	29	56	28	55	26	80
NF Left front		Cumulative toe growth (mm)	0	6	8	18	22	21	27	39	41	56	63	89
		2nd reference										0	26	
		Actual toe growth (mm)	0	6	2	10	4	-1	6	12	2	15	7	26
		Shoe type/Trim	RP,G	RP,G	RP,G	RBS,N	SS,N	SS,N	SS,N	SS,N	SS,N	NS	SP	NS
		Toe length at the time of recording (mm)	80	91	90	96	97	94	82	101	94	87	89	92
		Toe length after trimming (mm)										83		
		Date	19/03/2015	31/03/2015	7/05/2015	11/06/2015	13/08/2015	22/10/2015	11/11/2015	3/12/2015	24/03/2016			
7. Dave	17	Calender days	0	12	37	35	63	70	20	22	112			
NF Left front		Cumulative toe growth (mm)	0	0	5	11	22	35	39	46	76			
		2nd reference								0	30			
		Actual toe growth (mm)	0	0	5	6	11	13	4	7	30			
		Shoe type/Trim	RP,N	RP,N	RBS,N	HBS,N	SS,N	SS,N	SS,N	SP 86	RP,G			
		Toe length at the time of recording (mm)	81	85	94	90	98	96	98	106	94			
		Toe length after trimming (mm)								86				
		Date	12/03/2015	31/03/2015	30/04/2015	27/05/2015	11/06/2015	25/06/2015	6/08/2015	3/09/2015	7/10/2015	11/11/2015		
8. Dilly	11	Calender days	0	19	30	27	15	14	42	28	34	35		
NF Left front		Cumulative toe growth (mm)	0	0	9	16	16	18	28	32	42	49		
		2nd reference												
		Actual toe growth (mm)	0	0	9	7	0	2	10	4	10	7		
		Shoe type/Trim	RP,N	RP,N	RP,N	SS,N	HBS,N	HBS,N	SS,N	SS,N	RP,N	SS,N		
		Toe length at the time of recording (mm)	84	84	90	93	93	90	91	87	88	87		
		Toe length after trimming (mm)												
		Date	26/02/2015	31/03/2015	30/04/2015	18/06/2015	16/07/2015	6/08/2015	11/11/2015	19/11/2015	4/12/2015	24/03/2016		
9. Frank	17	Calender days	0	33	30	49	28	21	97	8	15	111		
NF Left front		Cumulative toe growth (mm)	0	1	11	19	24	27	46	48	50	81		
		2nd reference								0	2	31		
		Actual toe growth (mm)	0	1	10	8	5	3	19	2	2	31		
		Shoe type/Trim	RP,G	RP,G	RP,N	SS,N	RT,SS,N	SS,N	SS,N	SS,N	SP	RP,N		
		Toe length at the time of recording (mm)	89	78	90	86	86	85	91	85	87	86		
		Toe length after trimming (mm)									79			
		Date	12/03/2015	27/05/2015	25/06/2015	20/08/2015	17/09/2015	11/11/2015						
10. Henry (not Worked)	8	Calender days	0	76	29	56	28	55						
OF Right front		Cumulative toe growth (mm)	0	20	24	33	39	51						
		2nd reference												
		Actual toe growth (mm)	0	20	4	9	6	12						
		Shoe type/Trim	NS	SS,N	SS,N	SS,N	SS,N	NS						
		Toe length at the time of recording (mm)	74	87	88	95	92	91						
		Toe length after trimming (mm)												

		Date	19/03/2015	23/04/2015	21/05/2015	27/05/2015	16/07/2015	3/09/2015	22/10/2015	11/11/2015	7/12/2015	24/03/2016		
11. Jack	5	Calender days	0	35	28	6	50	49	49	20	26	108		
NF Left front		Cumulative toe growth (mm)	0	9	17	17	29	40	50	56	63	98		
		2nd reference									0	35		
		Actual toe growth (mm)	0	9	8	0	12	11	10	6	7	35		
		Shoe type/Trim	RP,N	SS,N	SS,N	SS,N	RT,SS,N	SS,N	SS,N	SS,N	SP	SS,N		
		Toe length at the time of recording (mm)	90	93	101	85	104	111	98	99	103	92		
		Toe length after trimming (mm)									89			
		Date	26/02/2015	19/03/2015	31/03/2015	7/05/2015	13/08/2015	20/08/2015	3/12/2015	25/02/2016				
12. Jonna	15	Calender days	0	21	12	37	98	7	105	84				
OF Right front		Cumulative toe growth (mm)	0	5	6	10	30	33	53	81				
		2nd reference							0	28				
		Actual toe growth (mm)	0	5	1	4	20	3	20	28				
		Shoe type/Trim	RP,G	RP,G	RP,G	RBS,N	SS,N	SS,N	SP	NS				
		Toe length at the time of recording (mm)	75	84	85	89	91	95	87	89				
		Toe length after trimming (mm)							84					
		Date	19/03/2015	31/03/2015	23/04/2015	30/04/2015	16/07/2015	13/08/2015	17/09/2015	22/10/2015	11/11/2015	19/11/2015	3/12/2015	24/03/2016
13. Phil	13	Calender days	0	12	23	7	77	28	35	35	20	8	14	112
OF Right front		Cumulative toe growth (mm)	0	1	6	8	23	29	37	42	47	48	53	91
		2nd reference										0	7	38
		Actual toe growth (mm)	0	1	5	2	15	6	8	5	5	1	5	38
		Shoe type/Trim	RP,N	RP,N	SS,N	SS,N	RT,SS,N	SS,N	SS,N	SS,N	SS,N	SS,N	SP	RP,G
		Toe length at the time of recording (mm)	79	85	86	87	99	97	95	91	92	92	97	90
		Toe length after trimming (mm)											81	
		Date	12/03/2015	31/03/2015	21/05/2015	27/05/2015	18/06/2015	6/08/2015	7/10/2015	11/11/2015	4/12/2015	17/12/2015	25/02/2015	
14. Raffy	8	Calender days	0	19	51	6	22	49	62	35	23	13	70	
NF Left front		Cumulative toe growth (mm)	0	3	11	12	13	22	35	44	47	53	96	
		2nd reference									0	6	43	
		Actual toe growth (mm)	0	3	8	1	1	9	13	9	3	6	43	
		Shoe type/Trim	SS,N	SS,N	SS,N	SS,N	SS,N	SS,N	RP,N	SS,N	SP	NS	SS,N	
		Toe length at the time of recording (mm)	84	90	100	93	92	95	91	97	97	85	88	
		Toe length after trimming (mm)									85			

