heterogeneous appearance of the epidymal tail observed one week after the vasectomy of the rams and two weeks after the vasectomy of the goats. The increased echogenicity of the epidymal tail at later stages might have been due either to the compression effects of the granuloma on the surrounding tissue, or to the tissue fibrosis.

Eight rams and seven goats have been uniaterally vasectomised for a number of different experimental purposes (Ahmad 1994). All the rams developed ultrasonically detectable sperm granuloma of the epididymal tail, but none of the goats did. Granuloma were observed in the epididymal head of one of the goats and in the vas deferens of the other six. Inpsissated semenlike material, probably due to leakage from the vas deferens, was observed in the space between the testis and segments of the epididymis in four of the goats.

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An evaluation of the accuracy of ageing horses by their dentition: changes of dental morphology with age

J. D. Richardson, P. J. Cripps, J. G. Lane

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Dental features are commonly expected to provide an accurate estimate of a horse’s age. In this study the dentition of 434 thoroughbreds was photographed and the individual dental features documented, the true age of all the horses was known. For each dental feature the correlation with true age was determined. The eruption of the incisor teeth was the most consistent feature but it was not totally reliable. The presence of a hook on the upper corner incisor and Galvayne’s groove proved to be no value when estimating age and, of the attributional features studied, the dental star showed the highest correlation with age. The results show that specific ages cannot be assigned to these dental criteria owing to the wide variation between individuals, and that as a result the estimation of age from dentition can never be precise.

It is commonly stated that the age of a horse can be determined from the appearance and conformation of its teeth, particularly the incisors. However, can this confidence in the existence of a correlation between dental morphology and age be justified? The ageing of horses from dental characteristics has attracted a wide range of commentary in the veterinary literature both before and after Galvayne made his claims of infallibility in 1912.

If no documented evidence of age is available an accurate estimate is extremely important for a purchaser, whether the horse is a broodmare, a competitive athlete or a general riding horse. There is a great need to establish whether the examination of a horse’s dentition can provide useful evidence of its age, and no previously recorded studies have evaluated the technique statistically.

The times of eruption of the incisor teeth and their rate of attrition are used in the estimation of age but these features may be influenced by numerous factors. In the later maturing breeds, such as the Haflinger, Lipizzaner and “cold-blooded” breeds, the eruption of the permanent incisors is said to be delayed by up to six months in some cases (Rosenberger 1955, Eiserrenger and Zettler 1985). With increasing age the rate of wear by attrition is influenced by environmental conditions. Belschner and Rosé (1982) reported that horses pastured on sandy soil wear their teeth much more rapidly than those raised on loamy soil with better pasture, or horses that are entirely stable-fed.

Many features of the incisor teeth have been used in age estimation, and some of them are said to be more reliable than others. In the literature a wide range of ages has been suggested for each individual feature. The times of eruption of the incisor teeth show smaller degrees of variation, but for the features that are altered by attrition there are large discrepancies in the reported values (Richardson and others 1994).

Materials and methods

A photographic record was made of the dentition of 434 thoroughbred horses with documented evidence of birth date. The photographic record consisted of lateral projections of the incisor and canine teeth and an occlusal view of the lower incisor tables.

The ages of the horses ranged from 11 months to 27 years. Information was collected about any vices displayed by each horse. All of the commonly used dental features were investigated. The presence and degree of eruption of the temporary and permanent incisors and the canine teeth were recorded, as was evidence of wear on the caudal edge of the lower permanent corner incisor. The lateral photographs made it possible to assess the incisor profile angle, and the presence of a "hook" or Galvayne’s groove on the upper corner permanent incisor was also determined. The occlusal view showed the shape of the lower incisor tables, the
The youngest male horse with a visible lower canine was three years 11 months and the youngest with a visible upper canine was four years three months. There was no significant correlation between the degree of eruption of the canine and age ($P=0.054$ for lower right canine and $P=0.3$ for the other canines).

**Upper corner incisor hooks**

A hook was present on the upper corner incisor of horses ranging from four years 10 months to 18 years nine months. Only 28.1 per cent of these horses had bilateral hooks. Fig 1 shows the distribution of ages over which a left hook of varying size was present. There was no significant association between the congenital malocclusion inferior brachygnathia and the presence of a hook on the upper corner incisor.

**Galvayne’s groove**

Galvayne’s groove was present on the permanent upper corner incisors of horses ranging in age from four years 11 months to 27 years nine months. Fig 2 shows the distribution of ages over which a left Galvayne’s groove was present.

**Incisor profile angle**

The correlation between the incisor profile angle and the true age was $0.786$ ($P=0.001$). Fig 3 shows the incisor profile angle plotted against true age. The scatter became more marked as the horses’ ages increased.

**Occlusal shape**

Fig 4 shows the shape of the left central tooth plotted against true age. The extent of the scatter shown on this graph limits the usefulness of tooth shape as a predictor of age.

**Infundibulum**

The youngest horse displaying a tooth with no infundibulum was just over three years old and the oldest horse with an infundibulum present on any tooth was just over 17 years. Fig 5

**Results**

**Eruption**

The oldest horse with a central temporary incisor still present was two years 11 months and the oldest horses with laterals and corners were four years and five years one month, respectively. The youngest horse with an erupted central permanent incisor was two years seven months, and the youngest horses with laterals and corners were three years three months and three years five months, respectively. The youngest animal showing complete wearing of the table of the corner tooth was four years three months but horses as old as eight years were observed with incomplete wear on the corner tooth.
FIG 3: Ages of horses with different incisor profile angles

demonstrates the age ranges over which the infundibulum in the
left central tooth decreased in size. The correlation between age
and the change in size of the infundibulum for all the incisors var-
ied between r=0.507 and r=0.742 (P<0.001) but the scatter was
more marked in the higher age ranges.

Enamel ring

The size of the enamel ring decreased with increasing age and
the oldest horse with an enamel ring present was 21 years. The
youngest horse without an enamel ring on any tooth was nine
years. The age ranges for different sizes of the left central enamel
ring are shown in Fig 6. The correlation between age and the size
of the enamel ring for all the incisors varied between r=0.700 and
r=0.834 (P<0.001), but, as with the infundibulum, the scatter
increased with increasing age.

Dental star

The youngest horse with a dental star was three years nine
months and the oldest horse with no dental star was just over 15
years. Fig 7 shows the extent of the changes in the size and shape
of the left dental star on the central incisor plotted against true
age. The correlation between age and the dental star of all the
incisors varied between r=0.771 and r=0.895 (P<0.001) but the
extent of the scatter increased with age, and the scatter is likely to
limit the usefulness of the size and shape of the dental star as a
predictor of age.

Discussion

The results of the study suggest that there are marked inconsis-
tencies between dental morphology and age. The inescapable con-
clusion is that any claims to accuracy in age determination from
dentition are fallacious.

The published data for the times of eruption of the temporary
and permanent teeth do not show any major discrepancies (Brown
1883, St Clair 1975, American Association of Equine
Practitioners 1988) but this study shows that exceptional examples
of ‘premature’ or ‘delayed’ eruption can occur. The range of ages
over which the temporary incisors were lost or the permanent
teeth erupted was wider than previously reported.

The frequently quoted ages for the eruption of the central, later-
al and corner permanent incisors are two years six months, three
years six months and four years six months (American
Association of Equine Practitioners 1988) but the times of erup-
tion of the permanent teeth were more variable in this study. The
youngest horse with a central permanent incisor was two years
seven months and in one horse of two years 11 months a central
temporary tooth was still present; in the corner position these
different ages were three years five months and five years one
month. This is in agreement with Cabasso (1975) who reported
three cases of five-year-old horses with temporary corner incisors
and indicates that even the eruption of the permanent incisors,
which was previously thought to be one of the more reliable indi-
cators of age (Wafa 1989), is not totally reliable.

Reference has been made to variations in the times of eruption
of teeth in horses of different breed types (Rosenberger 1955,
Eisenmenger and Zetter 1965). The results presented here are
from 434 thoroughbreds and thus the observed variations in erup-
tion times cannot be attributable to breed type.
Galvayne’s groove was observed in horses aged from four years 11 months to 27 years nine months and the oldest horse without a visible groove was 22 years six months. It is possible that the misinterpretation of the presence of a groove may account for the horses at the extremes of this age range. Despite this, horses in which the groove was clearly apparent in the upper half of the clinical crown had ages ranging from seven to 17 years. In many horses the length of the groove agreed with previously reported data but it cannot be assumed to be a reliable feature from which to predict age.

There was a statistically significant correlation between the occlusal angle and age but, as expected, the graph plotting the size of the angle against age showed an increase in the degree of scatter with increasing age. In spite of the significant correlation the occlusal angle is therefore of very limited value as a single predictor of age.

The ages at which the features of the incisor table are reported to change with attrition vary widely. It has been suggested that the central table becomes round at seven years (Tutt 1968) or 12 years (Eisenmenger and Zetter 1985), and this tooth is quoted as becoming triangular at eight years (Brown 1982) or 16 years (Montes 1978).

There was significant correlation between the shape of the table and age for all the incisor teeth but there was a marked degree of scatter which increased with age. For example, the age range for round left central incisor teeth was from five years to 15 years. This explains why the prediction of the age of an individual horse is not greatly helped by this feature, even though the correlation between shape and age was reasonably good for the whole population in the study.

The infundibulum is reported to disappear from the central, lateral and corner teeth at six years, seven years and eight years, respectively, in many texts (Goubaux 1892, Baker 1982, McMullan 1983). In this study the central incisor still displayed an infundibulum in many horses over six years old and even in a small number of horses over 10 years. The infundibulum of the corner incisor was up to 60 per cent of its original size for many horses older than 10 years. Again, the correlation between the size of the infundibulum and age was statistically significant but the large age ranges over which the infundibulum was worn away make this feature less important for the prediction of the age of individual horses.

The ages reported for the disappearance of the enamel ring from the central, lateral and corner incisors are also very variable, ranging from the frequently quoted 12 years, 13 years and 13 years, respectively (Goubaux 1892, American Association of Equine Practitioners 1988) to one text which indicates that this ring wears away on all the incisors between 19 years and 23 years (Ries 1986). In the present study only one horse under 15 years old had completely lost the enamel ring on any tooth, and this suggests that the enamel ring disappears when horses are older than is commonly quoted.

The correlation between the size of the enamel ring and a horse’s age was stronger than that between the size of the infundibulum and its age but, despite this, the extent of the scatter would limit its usefulness as a predictor of age.

The dental star is often said to appear on the central, lateral and corner incisor teeth at eight years, nine years and 10 years, respectively (Baker 1982, McMullan 1983, Mauller 1991). The results reported here show that the dental star appeared sequentially in the central, lateral and finally the corner incisor but that the ages at which it appeared were substantially earlier.

The dental feature best correlated with age was the dental star. As a result the changes in shape and size of the dental star are useful criteria for the estimation of age but the feature appeared to develop in younger horses than previously reported.

The principal conclusions to be drawn from this study are that the eruption and evidence of wear on the permanent corner incisors provide a useful guide to the age of horses up to five years but that even then there are marked exceptions to the general guidelines. Some features, such as the hook on the upper corner incisor and Galvayne’s groove, were useless.

The estimation of age from dental criteria depends on the bal-
Incidence of multiple ovulation and multiple pregnancy in mares

J. R. Newcombe

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TWIN or multiple ovulation (MO) and multiple pregnancy (MP) has been a widely recognised problem in thoroughbred mare populations throughout the world for many years (Andrews and McKenzie 1941, Ginther 1979). There is much published data on the incidence of MO in particular large surveys of abattoir material. In the UK, Arthur (1958) and David (1975) found an incidence of 18.5 per cent (n=792) and 18.9 per cent (n=194), respectively. Osborne (1966) found 14.5 per cent (n=2'736) in Australia and Saltiel and others (1982) 11.9 per cent (n=1'874) in Mexico. None of these surveys gave data on breed incidence but they would probably have included a proportion of ponies.

Less regard has been paid to the problem in non-thoroughbred mares and crossbred mares partly through paucity of data and partly because the incidence of MP was thought to be much lower than in the thoroughbred. Ginther (1992) emphasised the lower incidence in standardbred and Arab mares. No instances of MO were found by Arthur and Allen (1972) in a herd of Welsh ponies or by Satoh and Hoshi (1934) in Korean ponies. Ginther and others (1972) found only 2 per cent (n=126) and Wesson and Ginther (1981) 10 per cent (n=527) in abattoir surveys of pony ovariates.

A previous study by J. R. Newcombe (unpublished observations) found a significant breed variation in the MO rate of 952 ovariates based on rectal palpation only. Incidences of 25 per cent were found in thoroughbreds, 15 per cent in hunters, 28 per cent in Irish draught, 10 per cent in shire and Clydsdales, 15 per cent in riding pony types and 9 per cent in native ponies. Ginther (1979) summarised what little has been published on breed incidence.

The present study deals almost entirely with mares over 400 kg bodyweight resident on 10 stud farms in the UK during one breeding season. The data are divided for analysis only between thoroughbred and non-thoroughbred mares. The latter include cobs, Irish and British draught breeds, European warmbloods but mostly crossbred animals with 25 per cent to 75 per cent of thoroughbred blood.

Mares were maintained on a hay based diet with or without supplementary cereals until adequate pasture grass became available in late spring. From then, most were maintained entirely at pasture except for some mares with fuel at foot which received additional concentrates as necessary. The 10 stud farms were visited either daily (one stud), every 48 hours (five studs) or every 96 hours (four studs). Ovariates were first palpated for follicle-like structures and then examined with ultrasound using a 5 MHz linear transducer. Mares were examined throughout oestrus and all ovariates of 20 to 25 mm and above recorded. Ovulation was diagnosed by the disappearance of previously recorded follicles and their replacement by an area of low or moderate echogenicity (collapsed follicle) or high echogenicity (early corpus luteum). Accessory follicles present at ovulation were further examined until they either ovulated or regressed. Follicles which appeared to have haemorrhaged and/or liquefied without collapse were excluded from the data.

Mares were examined ultrasonographically for pregnancy 12