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OBSERVATIONS ON THE LENGTH AND ANGLE OF DECLINATION OF THE VULVA AND ITS RELATION TO FERTILITY IN THE MARE

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Summary. An instrument has been designed to measure the effective length (l) and the angle of declination (α) of the vulva in the mare. The product, $l\alpha$, provides an index (Caslick Index) suitable for determining the necessity for Caslick's operation in mares not exhibiting the classical symptoms associated with pneumovagina. The value l showed a significant increase ($P < 0{\cdot}05$) with increased age in breeding mares. Studies on 9020 mares revealed that all caslicked mares, and mares with a Caslick Index of <150, had a significantly higher pregnancy rate than non-caslicked mares of similar age and a Caslick Index >150. Values of 100 and over should be an indication for more careful clinical appraisal of the genital tract in those mares not as yet clinically affected. Nulliparous mares caslicked for racing had a significantly higher pregnancy rate than non-caslicked maiden mares in their first year at stud.

INTRODUCTION

Pneumovagina or wind-sucking is a well-known cause of reproductive failure in the mare. Caslick (1937) pointed out the importance of this condition in relation to genital infection. The principal contributory factors were changes in conformation of the vulva and persistent relaxation of the vulva; these changes were accentuated during oestrus. A vulval angle of at least 80° to the horizontal was considered desirable and where angles of 50° or less occurred, wind-sucking became clinically evident. A surgical procedure, universally known as Caslick's operation for closure of the upper vulval lips, was described which improved the fertility of mares affected with pneumovagina. Caslick's operation has also been used to correct pneumovagina in yearlings, 2-year-olds (Sager, 1966) and maiden racing mares (Roberts, 1971).

Bruner (1951), Delahanty (1968) and Sager (1966) all refer to various techniques which must be properly executed to ensure maximum benefit following this simple operation. These reports relied on clinical observations of vulval tone, thickness of vulval lips, presence of foreign material in the vagina, frothy mucus on the cervix, ballooning of the vagina and, in extreme cases, ballooning of the uterus. The importance of correct surgical technique has been adequately emphasized (Delahanty, 1968). Poor anatomical confor-

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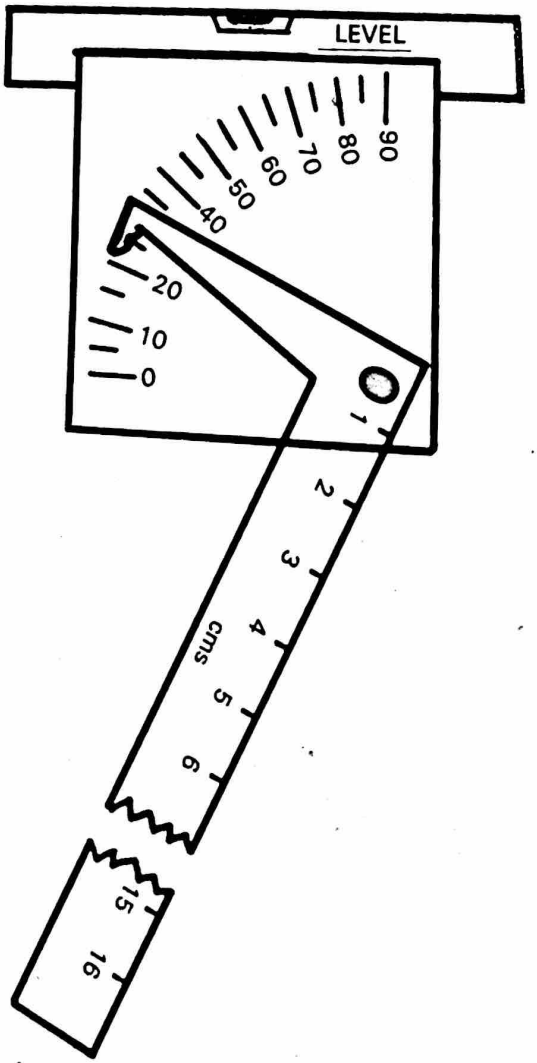
mation, poor physical condition, muscle atrophy due to old age, and relaxation of pelvic ligaments during oestrus, are predisposing factors related to pneumovagina.

Du Plessis (1964) found that Caslick's operation decreased the overall incidence of anoestrus and increased conception rates in potential or apparent cases of pneumovagina. He also observed that indiscriminate operations on *all* mares did not lower the total abortion rate.

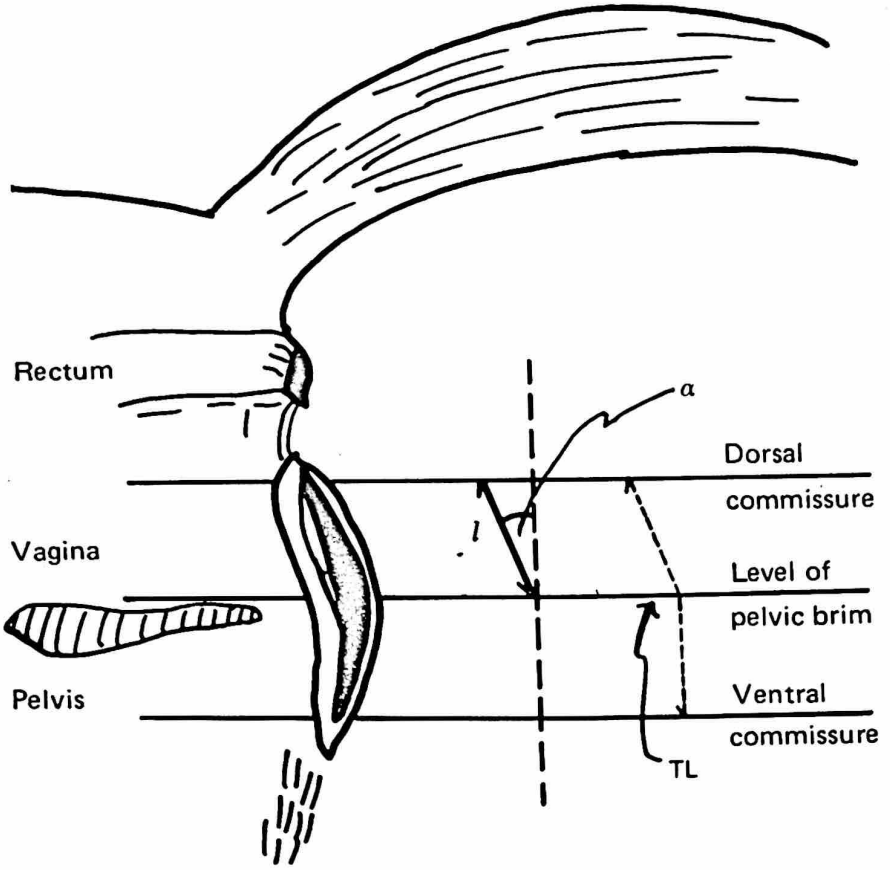
This paper presents the results of a study which relates the length and angle of declination of the vulva to fertility and provides an easily made measurement, the Caslick Index, which can be used in conjunction with clinical evaluation to provide a more scientific basis for the use of Caslick's operation. These studies were conducted between 1967 and 1977.

MATERIALS AND METHODS

A total of 9020 mares, including 377 maiden mares, on 19 Thoroughbred, 2 Standard bred and 1 Arabian stud farms in southern Queensland, Australia, were initially examined in oestrus and vulval measurements were taken with a stainless-steel measuring device (Text-fig. 1). This consisted of a half protractor (0–90°), an arm calibrated in cm and pointer attached to and pivoted at the base of the protractor, which had a spirit level fixed to its upper edge.



Text-fig. 1. A stainless-steel measuring device (vulvometer) for determination of effective length and angle of declination of the vulva (Caslick Index).



Text-fig. 2. Anatomical relationship of the vulva of the mare showing measurement sites. α = angle of declination; l = effective length of vulva; TL = total length of vulva.

The parameters measured were: (1) total length (TL), (2) effective length (l) and (3) angle of declination (α) of the vulva. These are illustrated in Text-fig. 2. Examinations were made during oestrus with the mare standing on a horizontal floor. Care was taken during measurement not to upset the mare, as arching of the back, straining, or placing the hind feet further forward than normal all reduce the declination angle being measured. It was found to be important to raise the tails to a uniform vertical position as some mares resented the instrument touching the anal area for the first time, even after preliminary manual contact before taking the measurements.

It soon became apparent that, due to differences in conformation, the parameters α and l, while important individually, might provide more practical information if combined based on the equation that radius (in cm) × angle (in radians) = the length of an arc (in cm). As α was measured in degrees, not radians, the arc length so obtained is not in the correct units. However, since $180° = \pi$ radians, all arcs so obtained differ by the same common multiple from the true arc length and therefore any comparisons between them are valid. As the more direct measurement $l \times \alpha$ can be made accurately and quickly in the field using the instrument described, this product was used as a practical basis for a Caslick Index.

Vulval, vaginal and rectal examinations, as well as uterine swabbing for bacteriological tests, were routinely conducted. At the time of vaginal and cervical examinations, a clinical assessment was made regarding the presence of pneumovagina. All lactating mares requiring Caslick's operation on clinical grounds were usually sutured after foaling or after first service. Barren mares

with clinical evidence of inflammation were caslicked and re-examined at the next oestrus before breeding. Some mares, already caslicked, which entered the group from other breeding areas were continually kept sutured irrespective of measurements.

Age, nutritional status, day of expected ovulation, service dates and the result of a 42-day pregnancy examination were recorded for each mare. The 377 maiden mares were analysed separately. Maiden and aged mares (>20 years), which failed to conceive after 2 breeding seasons, were excluded.

RESULTS AND DISCUSSION

The age distribution of all the mares studied is included in Table 1. Of these, 2110 were caslicked with the majority (99%) being Thoroughbreds. The total vulval length (TL) varied from 5 to 15 cm, effective length (l) from 1 to 8 cm and angle (α) from 0 to 80°. No relationship between TL and fertility was evident, but l increased significantly with age ($P = <0{\cdot}01$) (Table 1).

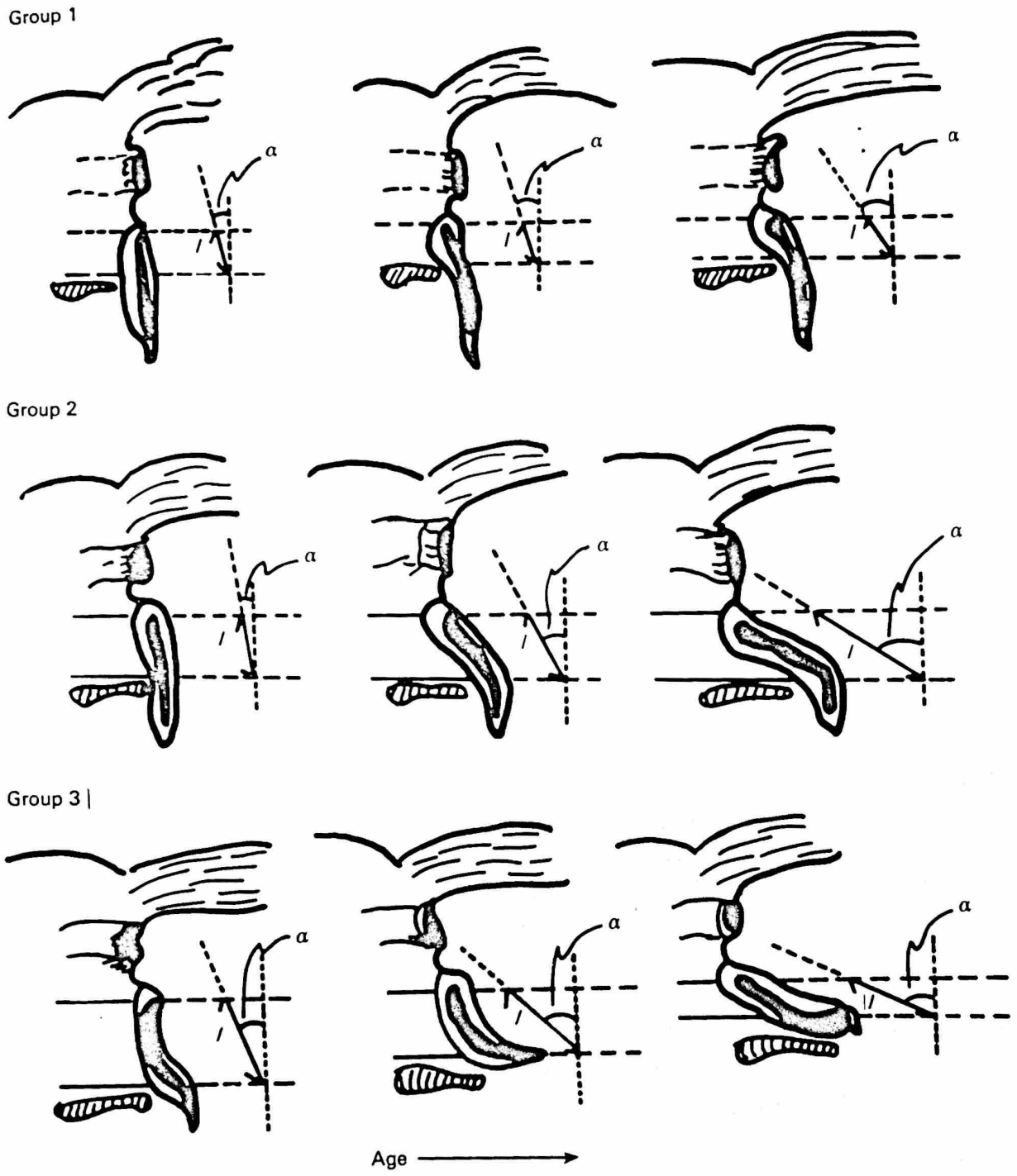
Table 1. Distribution of mares by age, number, average effective and effective vulval length > 4 cm

Age (years)	No. of mares	Average effective vulval length (cm)	Effective vulval length: >4 cm (%)
3	347	3·6	14
4	686	3·8	25
5	903	4·0	34
6	960	4·2	38
7	928	4·3	45
8	851	4·1	52
9	682	4·5	53
10	615	4·1	54
11	518	4·6	57
12	520	4·6	53
13	417	4·7	62
14	366	4·7	67
15	301	4·8	68
16	231	4·6	63
17	188	4·8	70
18	160	4·8	65
19	141	4·9	60
20	102	4·7	73
>20	104	5·0	79

Three conformation types were recognized (Text-fig. 3) and, based on anatomical position of the anus, tail setting and brim of the pelvis, these can be classified as follows.

Group I. These mares had an effective length of 2–3 cm, a Caslick Index of <100, and were rarely sutured even when aged. Poor fertility in these mares was usually due to other faults associated with poor stud management. These mares, when moved to other breeding farms, often became normal breeders without requiring Caslick's operation.

Group II. These mares had an effective length of 6–7 cm and a Caslick Index of >50. Mares in this group were often predictable, even as 3-year-olds, as their pelvic brim was usually >4 cm from the dorsal commissure of the vulva. With



Text-fig. 3. Vulval changes in the 3 conformation groups (see text for description) as affected by increasing angle of declination (α) and effective length of vulva (l).

age, an increase in both length and angle of declination resulted in an Index >150 due to further relaxation of the pelvic organs and ligaments.

Group III. The mares in this group had an effective length of 5–9 cm and a Caslick Index that varied from 50 to >200. These mares had serious reproductive problems, often required a Caslick operation at a young age, and proved difficult to breed naturally. They showed a dished vulval conformation with the brim of the pelvis almost at the lowest point of the entire measurement. Caslick's operation was not always successful because when sutured to below the level of the pelvic brim as little as 2 cm may remain unsutured, thus preventing natural service.

While the majority of the mares can be placed in one of these three categories, it must be realized that due to inherited conformation defects, a gradation exists related to the effective length of the vulva, which in Group III is little different from its total length because of the dish-shaped nature of the vulval conformation. Greater reliance can therefore be placed on the use of the Caslick Index, especially in examination of fillies as future brood mares.

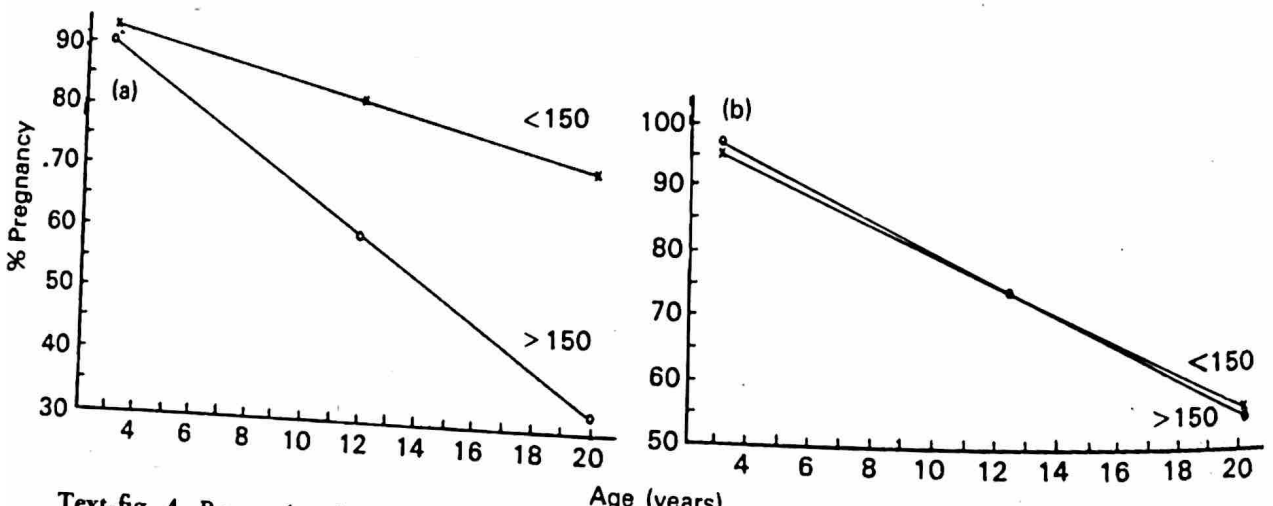
During the period of study, a conservative attitude to Caslick's operation was maintained. The proportion of mares caslicked (23·4%) is low compared with other practice figures in Australia where, in some instances, it is over 30%. Normal clinical criteria of pneumovagina were used as a guideline for suturing. However, analysis of mares with a Caslick Index >150 showed a significantly lower number of pregnancies at all ages. It is therefore suggested that all mares, irrespective of age, be sutured if they fall into this category.

A Caslick Index of 150 was used as the median to compare pregnancy rates between caslicked and non-caslicked mares by age (see Text-fig. 4). No significant difference was found between groups of caslicked mares, regardless of their Caslick Index. However, pregnancy rate was significantly ($P = <0{\cdot}05$) lower in non-caslicked mares with an Index >150 as compared with that of mares with one of <150. All groups of mares showed a decrease in pregnancy rate with age.

In all mares studied, no significant difference in fertility was found in those with a Caslick Index <150 whether they were caslicked or not. However, those with an Index of 101–150 did approach significance, indicating that a close clinical watch should be kept on all mares with an Index of >100.

The importance of taking the measurements during oestrus cannot be too strongly stressed. Lieux (1972) found that mares having pneumovagina during oestrus were often without clinical signs during dioestrus. Similarly, in this survey, mares which were pregnant or in dioestrus, had both shorter effective and total vulval lengths, and many showed a decrease in angle as well. A measurement index on these mares would give a false low index.

Of the 377 maiden mares, all 46 that had been caslicked for racing became pregnant in their first breeding season: a very high proportion (89%) of the



Text-fig. 4. Regression lines on age of the numbers of (a) non-caslicked and (b) caslicked mares becoming pregnant with a Caslick Index of <150 (x) and >150 (O). The regression coefficients were: (a) $r = 0{\cdot}88$ for an index of <150, and $r = 0{\cdot}74$ for >150 ($P < 0{\cdot}05$); (b) $r = 0{\cdot}88$ for an index of <150, and $r = 0{\cdot}87$ for >150.

remainder (331) also became pregnant at this time. In non-caslicked maiden mares, the Caslick Index alone was not a significant indicator of subsequent fertility.

Young mares in work have little body fat and, consequently, some may exhibit a high Caslick Index. Roberts (1971) had indicated that such mares frequently suffered from 'cramp', 'stitches' or 'flatus vaginalis'. Many of these were caslicked to race, but when retired for breeding they usually improved in bodily condition and, consequently, when measured to obtain a Caslick Index, often gave indices not significantly different from those of non-caslicked fillies.

It was found that effective length of the vulva increased significantly with age. The relative importance of this was related to mares which were marginal as far as α was concerned. In this respect, young mares with a Caslick Index of 125 (5 cm × 25°) can easily and unobtrusively after several foals, with a resultant increase in α, acquire an Index of 150 (6 cm × 25°). Subsequent loss of condition, further ageing, etc., will increase the angle imperceptibly and the mare then enters the category requiring suturing, often without other clinical signs save those of return to service.

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