An analysis of canine hair re-growth after clipping for a surgical procedure

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Abstract Hair growth and replacement have been studied extensively in humans, sheep and laboratory rodents, but in dogs and other mammalian species few studies have been published. The objectives of this study were: (1) to determine the time required for the hair to re-grow in dogs after clipping for a surgical procedure; (2) to define whether the season of the year influenced the period of time required for re-growth and; (3) to determine if season might influence the telogen: anagen ratio. Eleven Labrador retrievers were recruited during spring, 10 during summer, six during autumn and 10 during winter. Hairs re-grew to their preclipped length in 14.6 weeks, 14.5 weeks, 13.6 weeks and 15.4 weeks when shaved in the spring, summer, autumn and winter, respectively. The differences in these values were not significant suggesting that season has no effect on the rate of hair re-growth in Labrador retrievers housed indoors ($P = 0.12$). The mean values for the telogen: anagen ratio in each season were: 5.2 (spring), 6.1 (summer), 9.5 (autumn), and 5.3 (winter). The differences in these values also were not significant ($P = 0.89$). The percentage of hairs in telogen was over 80% in all four seasons.

Keywords: anagen, canine, hair cycle, hair growth, photoperiod, season, telogen, temperature.

INTRODUCTION

After completion of morphogenesis, the hair follicles enter a continuous cycle of growth (anagen), regression (catagen), and quiescence (telogen), followed by shedding of the hair (exogen) and the formation of a new anagen follicle.\(^1\) In the follicles of sheep, canine breeds that need clipping, such as poodles, and the human scalp, the anagen stage of the hair cycle predominates; however, this is unusual for most mammalian species in which a telogen stage predominates.\(^1,2,3\)

The hair cycle is controlled by complex interactions between endogenous and exogenous factors. Endogenous factors include cytokines and growth regulators, which have a local effect, and hormones, which have a systemic effect.\(^4\) Important exogenous factors include photoperiod and temperature. These environmental-related factors control the secretion of melatonin and prolactin, which directly influences the cyclical activity of the hair follicles observed throughout the year.\(^5,6,9,10\) It is also believed that photoperiod, with some participation of temperature, can indirectly influence the hair cycle by acting on the hypothalamus-hypophysis axis and affecting the secretion of steroid and thyroid hormones known to influence the hair cycle activity in humans and animals.\(^11,12\)

Hair growth and replacement have been studied extensively in humans, sheep and laboratory rodents, but few studies have been published in other mammalian species. Factors thought to affect hair growth and replacement in dogs and cats are environmental changes, age, sex hormones, region of the body and breed.\(^3,13–19\)

The dog’s hair coat is of great esthetic importance to most dog owners, and any site where the hair coat is thinned or absent can be a cause of concern and distress to them. This is especially true when the absence of hair is due to failure of hair to re-grow after a site has been clipped for a surgical procedure. It is estimated that the average time required for canine hair to re-grow post clipping ranges from 3 to 4 months for short-coat breeds and as long as 18 months for long-coat breeds.\(^20\) In some cases, it may take years for hair to re-grow after clipping for surgical or other procedures. This condition is called post-clipping alopecia and the current knowledge regarding this phenomenon is speculative and anecdotal. This is largely because little is know about the process of canine hair re-growth. A first step in understanding post-clipping alopecia is to have an estimate of the time required for the hair to re-grow when post-clipping alopecia does not occur.

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**MATERIALS AND METHODS**

**Dogs**
Privately owned Labrador retrievers, scheduled for cruciate ligament repair at the Veterinary Teaching Hospital of the University of Minnesota were included in the study. A group of dogs was recruited in each of the four seasons. The decision to recruit only Labrador retriever dogs undergoing the same type of surgery eliminated any possible effects that breed and site of the body clipped had on the time required for the hair to re-grow. In addition, to minimize the influence of reproductive hormones on hair re-growth, all dogs were either spayed females (18 dogs) or castrated males (19 dogs). Their ages ranged from 2 to 8 years.

The inclusion criterion was that all dogs had no history or clinical signs of systemic disease at the time of surgery, with the exception of the ruptured cruciate ligament. A thorough physical examination, complete blood cell count (CBC) and chemistry profile were performed on all dogs before surgery to evaluate their health status. In addition, serum total thyroxine (TT4) concentration was measured on each dog to assess thyroid function because delay in hair re-growth post clipping can be the only clinical sign of hypothyroidism. Serum TT4 concentration was the selected test because delay in hair re-growth post clipping can be the only clinical sign of hypothyroidism. Serum TT4 values were below the reference range further testing can be the only clinical sign of hypothyroidism, and any medications known to affect thyroid function tests were taught how to pluck hairs on the day that the animals were discharged as follows: a group of hairs were plucked from the clipped area. Owners were taught how to pluck hairs on the day that the animals were discharged as follows: a group of hairs were plucked from the clipped area. Owners were taught how to pluck hairs on the day that the animals were discharged as follows: a group of hairs were plucked from the clipped area. Owners were taught how to pluck hairs on the day that the animals were discharged as follows: a group of hairs were plucked from the clipped area. Owners were taught how to pluck hairs on the day that the animals were discharged as follows: a group of hairs were plucked from the clipped area.

**Follow-up of hair re-growth**
Ten hairs shafts initially plucked for the unit area trichogram were measured from tip to root. The average hair length was considered as the original length for the site that was followed up after clipping (lateral thigh). The follow-up of hair growth after clipping was conducted as follows: the owners were called every 14 days after the hair was clipped and asked if a thin layer of hair was present. When this stage was reached, the owner was requested to send to the investigator, every 2 weeks, hairs plucked from the clipped area. Owners were taught how to pluck hairs on the day that the animals were discharged as follows: a group of hairs were to be firmly grasped with the finger tips, then plucked in the direction of the hair growth using a rapid movement to avoid breakage of the hair shaft. The average length of the hair shafts from the clipped area mailed by the owners were determined each time and compared with the average length recorded before clipping. When the hairs from the clipped area reached the original length, one of the investigators (SD) examined the dog to ensure that the hair coat had re-grown completely. The time required for the hair to re-grow after clipping was recorded in weeks for each season of the year.

**STATISTICAL ANALYSIS**
One-way analysis of variance (ANOVA), was used to compare the time required for the hair to re-grow and the hair telogen: anagen ratio among the four seasons of the year. Differences were considered statistically significant at $P \leq 0.05$. Analysis was carried out using Microsoft Excel for Windows 2.0.

**RESULTS**

**Animals**
Thirty-seven Labrador retriever dogs were included in the study. All dogs were considered to be in good health based on unremarkable findings on physical health status. In addition, serum total thyroxine (TT4) concentration was measured on each dog to assess thyroid function because delay in hair re-growth post clipping can be the only clinical sign of hypothyroidism.
It has been stated that it takes 3–4 months for the hair to re-grow after clipping in dogs with short coats,20 but there has been no scientific investigation to support this statement. The results of our study corroborate this information, showing an average of 3.7 months for the hair of Labrador retrievers to re-grow after clipping in different seasons throughout the year.

Seasonal changes in hair coat have been described in several species.12,15,17,25–28 The length of photoperiod appears to be the predominant factor regulating seasonal variations in coat growth through the influence of plasma prolactin concentrations mediated by melatonin signals from the pineal gland. In winter, when days are short, prolactin levels in the pineal gland increase, resulting in lower prolactin levels and the growth of winter pelage. As the day length increases in spring, this situation reverses, leading to a spring shed.9,29 In addition to the dominant effect of photoperiod, ambient temperature also modulates these seasonal changes. For example, in goats maintained under the same photoperiod, modification of the environmental temperature either delayed the development of a summer coat, when the animals were maintained under low temperatures, or produced a premature molting of the winter coat when kept under high temperatures.9 The mechanism of action of melatonin and prolactin in modulating hair growth is not fully understood. However, prolactin has been found to have an inhibitory effect on murine and Cashmere goat hair cycle.30,31 Recent studies showing the presence of prolactin receptors on dermal papilla and outer root sheath suggest a direct action of prolactin on hair follicles.30–32 On the other hand, the effect of melatonin appears to be indirect through the regulation of prolactin secretion by the pituitary gland.6,8,33

Little information exists on the effect of seasonal changes on canine hair growth. Al-Bagdadi and collaborators15 observed a faster rate of hair growth during the winter, corroborating findings observed in cats.13,28 On the other hand, Butler and Wright17 and Gunaratnam and Wilkinson16 have shown a faster hair growth rate in summer and minimum hair follicle activity during the winter. Similar to our study, these investigations were conducted in regions of the world with high latitude and marked temperature variations among the seasons.13,15,17,18,28 However, we did not observe significant differences in the time required for the hair to re-grow when clipping was performed during different seasons of the year. The lack of effect of seasonal changes in hair growth could be explained, at least in part, to the housing conditions of our dogs. Previous studies have been conducted with dogs housed outside and, therefore, exposed to marked seasonal changes in temperature and photoperiod. In contrast, the dogs in our study were housed predominantly indoors and spent 90% or more of their days inside their houses. In this case, the total number of natural or artificial hours of light to which the dogs were exposed during 24 h probably did not vary substantially throughout the year. According to the owners, the dogs in the study were exposed to approximately 16 h of light and 8 h of darkness. In addition, because of the extreme temperature variation observed in the Upper Midwest (average temperature in summer 29.2 °C and in winter minus 14.5 °C) (The National Climate Data Center. November 15, 2002; http://lwf.ncdc.noaa.gov/ao/ncdc.html – accessed November 2002), the temperature was controlled artificially in the environments where these dogs resided. Temperature fluctuations reported to affect hair growth have ranged from 8 to 10 °C.5,11,18 The highest variation in temperature throughout the year inside the houses of the dogs in our study was 5.6 °C and, in most of them, the environmental temperature varied by 1 to 3 °C. As a result, the animals in this study were not exposed to large seasonal variations in ambient temperature except for brief periods when they were let outside. Therefore, it is likely that the modest variations in the proportion of hours of light vs. hours of dark and the mild changes in ambient temperature during the different seasons were not sufficient to affect the time required for hair re-growth on the dogs in our study. Additionally, it can be hypothesized that local factors such as inflammatory cytokines and/or growth regulators released at the surgical site stimulated the hair re-growth post clipping and neutralized any
effect that season variations of photoperiod and/or temperature had on the hair re-growth.

Hair growth and replacement in dogs have been shown to occur in a mosaic pattern, with adjacent hairs in different stages of the hair cycle at any time. However, this pattern can fluctuate seasonally. Two peaks of maximum activity, one in winter and one in summer, with a high percentage of hairs in the anagen phase, were observed in beagle dogs. Seasonal variations in the proportion of hairs in anagen and telogen have also been described in cats, ferrets, goats and humans. In contrast to the findings reported by Al Bagdadi and collaborators we did not find a significant difference in the telogen: anagen ratio among the four seasons. As mentioned before, one possible explanation for these findings is that the dogs in the different groups were not exposed to marked changes in daylight length or temperature throughout the year as they were housed indoors.

In this study, we observed that the majority of hairs of the Labrador retriever dogs were in telogen, corroborating previous reports stating that Labrador retrievers have a telogen predominant hair cycle. However, we found proportionally more hairs in telogen (at least 80%) compared to the previous investigators (approximately 50%). It is difficult to critically discuss the differences among the studies because no information was provided on the previous reports regarding the number of Labrador retrievers sampled, the sex of the dogs, the area of the body and the time of the year that samples were collected. Nevertheless, this discrepancy can be partially explained by the use of different techniques to assess the phases of the hair cycle (histology vs. trichogram). Another, less likely explanation, would be an underestimation of anagen counts due to the breakage of anagen hair shafts above the root during plucking. In this study, an average of 10.4% plucked hairs had broken-off roots and these hairs were not included in the data analysis because their phases cannot be determined for certain. Nevertheless, even if these hairs were included in the anagen count, the percentage of telogen hairs would not have changed significantly.

The proportion of hairs in telogen and anagen did not differ significantly among the seasons in our study. However, variations among seasons would be expected if the dogs were housed outside and exposed to the marked differences in temperature and photoperiod present in the climate conditions of the Midwest of the United States.

To avoid interference of factors, other than season, we only included neutered Labrador retrievers and the same area of the body (lateral thigh) was clipped on all animals. However, future research needs to be conducted to investigate if breed, sex hormones and body location have any influence on the rate of hair regrowth post clipping which may help us better understand the pathogenesis of post clipping alopecia and other hair re-growth disorders in dogs.

In summary, the results of our study showed that it took an average of 14.7 weeks for the hair to re-grow independent of the season in which the hair was clipped in a population of Labrador retrievers housed predominantly indoors and living in the climatic conditions of the Midwest of the United States. In addition, the telogen: anagen ratio was not significantly different among the four seasons and the telogen phase predominated.

REFERENCES


**Résumé**  L’étude de la croissance et du cycle pilaires a été réalisée avec précision chez l’homme, le mouton et les rongeurs de laboratoire, mais peu d’études ont été publiées chez le chien ou d’autres espèces de mammifères. Les buts de cette étude étaient: 1) de déterminer la durée requise pour obtenir une repousse pilaire après tonte 2) de définir si la saison de l’année influence le temps de repousse et 3) de déterminer si la saison influence le ratio télougène: anagène. Onze Labrador retrievers ont été recrutés pendant le printemps, 10 pendant l’été, 6 pendant l’automne et 10 pendant l’hiver. Les poils ont repoussé en moyenne après 14.6 semaines, 14.5 semaines, 13.6 semaines et 15.4 semaines quand le rasuré se réalisa pour cirugía; 2) definir si la estación del año influye sobre el tiempo requerido para volver a crecer y; 3) determinar el tiempo necesario en el perro para que el pelo vuelva a crecer después de ser rasurado en 14.6 semanas, 14.5 semanas, 13.6 semanas y 15.4 semanas cuando el rasurado se realizó de antes del rasurado en 14.6 semanas, 14.5 semanas, 13.6 semanas y 15.4 semanas y 15.4 semanas cuando el rasurado se realizó en 14.6 semanas, 14.5 semanas, 13.6 semanas y 15.4 semanas cuando el rasurado se realizó en 14.6 semanas, 14.5 semanas, 13.6 semanas y 15.4 semanas cuando el rasurado se realizó en 14.6 semanas, 14.5 semanas, 13.6 semanas y 15.4 semanas cuando el rasurado se realizó en 14.6 semanas, 14.5 semanas, 13.6 semanas y 15.4 semanas cuando el rasurado se realizó en 14.6 semaines, 14.5 semaines, 13.6 semaines et 15.4 semaines pour chacune de ces saisons respectivement. Les différences observées n’étaient pas significatives, ce qui suggère que la saison n’a pas d’impact sur la poussée des poils pour les Labrador retrievers vivant en intérieur (*P* = 0.12). Les valeurs moyennes du rapport télougène/anagène étaient: 5.2 (printemps), 6.1 (été), 9.5 (automne), et 5.3 (hiver). Ces différences ne sont pas significatives (*P* = 0.89). Le pourcentage de poils en télougène était supérieur à 80% quelle que soit la saison.

**Resumen**  El crecimiento y sustitución del pelo ha sido estudiado ampliamente en humanos, ovejas y roedores de laboratorio, pero se han publicado pocos estudios sobre perros y otros mamíferos. Los objetivos de este estudio fueron: 1) determinar el tiempo necesario en el perro para que el pelo vuelva a crecer después de ser rasurado para cirugía; 2) definir si la estación del año influye sobre el tiempo requerido para volver a crecer y; 3) determinar si la estación puede influir el índice telogen: anagen. Once Labrador retrievers fueron recrutados durante el printemps, 10 durante el été, 6 durante el automne et 10 durante el hiver. Les poils repus en moyenne après 14.6 semaines, 14.5 semaines, 13.6 semaines et 15.4 semaines pour chacune de ces saisons respectivement. Les différences observées n’étaient pas significatives, ce qui suggère que la saison n’a pas d’impact sur la poussée des poils pour les Labrador retrievers vivant en intérieur (*P* = 0.12). Les valeurs moyennes du rapport télougène/anagène étaient: 5.2 (printemps), 6.1 (été), 9.5 (automne), et 5.3 (hiver). Ces différences ne sont pas significatives (*P* = 0.89). El porcentaje de pelos en télougène era superior a 80% cuando era la temporada.

**Zusammenfassung**  Haarwachstum und –wechsel sind bei Menschen, Schafen und Laborratten intensiv untersucht worden, bei Hunden und anderen Säugetierarten jedoch sind nur wenige Studien veröffentlichte.
worden. Ziel dieser Studie ist es: 1.) zu bestimmen, wie viel Zeit für das Nachwachsen von Haare nach Scheren für einen operativen Eingriff notwendig ist, 2.) zu ergründen, ob die Jahreszeit den Zeitraum, der für das Nachwachsen nötig ist, beeinflusst, 3.) zu bestimmen, ob die Jahreszeit das telogen:anagen-Verhältnis beeinflussen kann. Elf Labrador-Retriever wurden während des Frühlings, 10 während des Sommers, 6 im Herbst und 10 im Winter rekrutiert. Haare wuchsen wieder nach 14,6 Wochen, 14,5 Wochen, 13,6 Wochen und 15,4 Wochen, nachdem sie im Frühling, Sommer, Herbst beziehungsweise Winter geschoren wurden. Die Unterschiede bei diesen Werten waren nicht signifikant, was ein Hinweis darauf ist, dass die Jahreszeit keinen Einfluss auf die Rate des Nachwachsens bei Labrador-Retrievern, die im Haus gehalten werden, hat ($P = 0.12$). Die Durchschnittswerte für das telogen:anagen-Verhältnis in den einzelnen Jahreszeiten waren: 5,2 (Frühling), 6,1 (Sommer), 9,5 (Herbst), und 5,3 (Winter). Die Unterschiede bei diesen Werten waren nicht signifikant ($P = 0.89$). Der Anteil der telogenen Haare war in allen vier Jahreszeiten über 80%.