Zahnprobleme bei Nagern und Kaninchen: Was ist wirklich ein Problem und was ist die Lösung?

Marcus Clauss & Jean-Michel Hatt

Louise Martin, Jacqueline Müller, Daryl Codron, Ellen Schulz-Kornas, Jürgen Hummel, Mikael Fortelius, Patrick Kircher

Klinik für Zoo-, Heim- und Wildtiere, Vetsuisse-Fakultät, Universität Zürich

University of Zurich[UZH]

Clinic of Zoo Animals, Exotic Pets and Wildlife

Überblick

Zahnprobleme bei Kaninchen und Nagern

- Kauen ist wichtig
- Zahnprobleme sind häufig
- Mögliche Ursachen
  - Mineralstoff-Mangel
  - Ungenügender Zahnabrieb
    - Abrieb und Wachstum bei Kaninchen und Meerschweinchen
  - Futter-Typ
  - im Ausschluss: Genetik
- Empfehlungen

Kauen ist wichtig

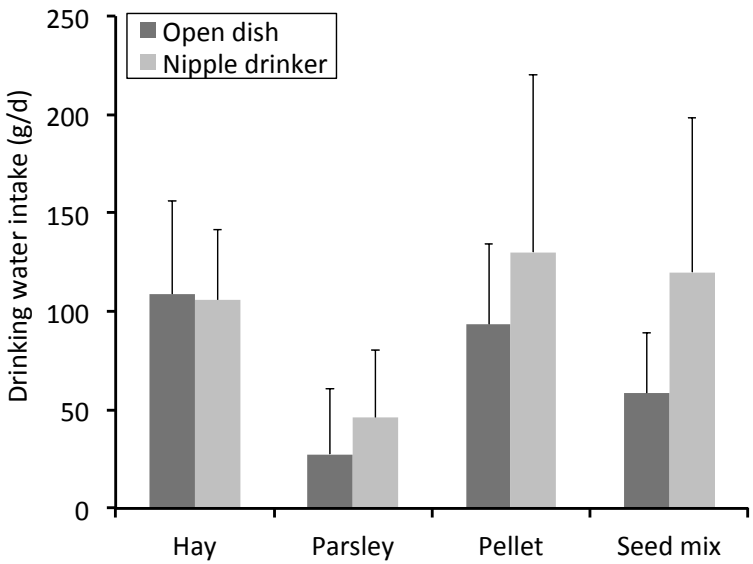
Journal of
Animal Physiology and Animal Nutrition

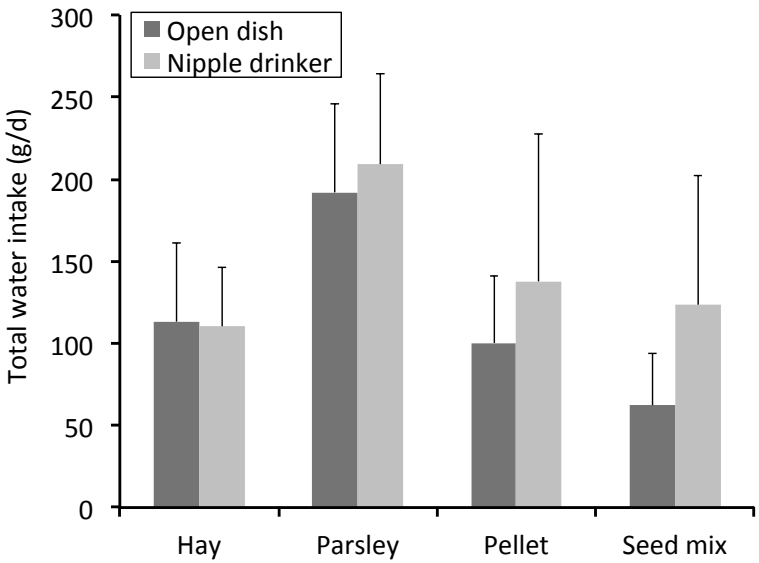
DOI: 10.1111/jpn.12549

ORIGINAL ARTICLE

Guinea pig (*Cavia porcellus*) drinking preferences: do nipple drinkers compensate for behaviourally deficient diets?

A. Balsiger[1], M. Clauss[1], A. Liesegang[2], B. Dobenecker[3] and J.-M. Hatt[1]





Zahnprobleme kommen häufig vor

Vergleichende Untersuchung zur Krankheitsverteilung bei Kaninchen, Meerschweinchen, Ratten und Frettchen

M. Langenecker[1]; M. Clauss[1]; M. Hässig[2]; J.-M. Hatt[1]

Tierärztl Prax 2009; 37 (K): 326–333

Tab. 1 Klinische Befunde zu den häufigsten Erkrankungen bei Kaninchen (n = 2125), Meerschweinchen (n = 2009), Ratten (n = 651) und Frettchen (n = 152), die zwischen 1994 und 2003 an der Klinik für Zoo-, Heim- und Wildtiere der Vetsuisse-Fakultät Zürich vorgestellt wurden

		Häufigste Befunde	Anteil (%)
Kaninchen			
Zahnerkrankungen	14%	Zahnanomalien	100
		Appetitlosigkeit	60
		Umfangsvermehrung am Kiefer	11
		Augenausfluss	9
		Foetor ex ore	9
		Hypersalivation	9

Vergleichende Untersuchung zur Krankheitsverteilung bei Kaninchen, Meerschweinchen, Ratten und Frettchen

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		Häufigste Befunde	Anteil (%)
Meerschweinchen			
Zahnerkrankungen	12%	Zahnanomalien	100
		Inappetenz	47
		Gewichtsverlust	21
		Maulhöhlenveränderung	18

Diseases in pet degus: a retrospective study in 300 animals

V. Jekl, K. Hauptman and Z. Knotek*

Journal of Small Animal Practice (2011) **52**, 107–112

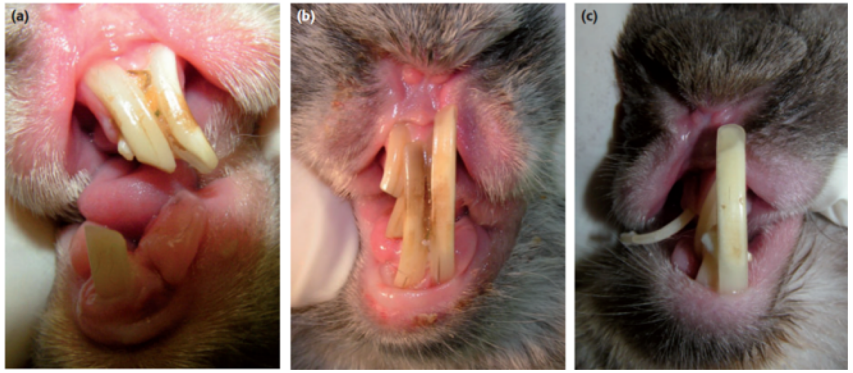
Results: The most common diseases in degus were (1) acquired dental disease (60·0%) with significantly higher prevalence in older animals (P<0.001), (2) skin alopecia due to fur chewing (13·33%) and (3) lens cataracts (13·33%). Other common disorders included traumatic injuries to soft tissues

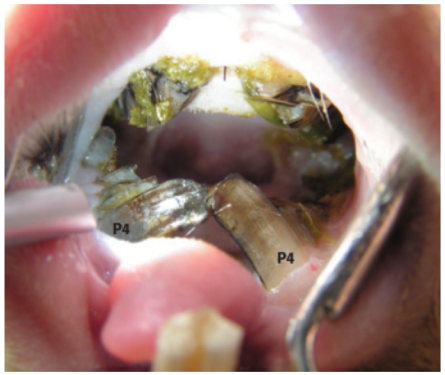
Quantitative and qualitative assessments of intraoral lesions in 180 small herbivorous mammals

Veterinary Record (2008)
162, 442-449

V. Jekl, K. Hauptman, Z. Knotek

Between 2002 and 2005 210 rabbits, 257 guinea pigs and 123 chinchillas were examined; oral disease was diagnosed in 38·1 per cent of the rabbits, 23·4 per cent of the guinea pigs and 32·5 per cent of the chinchillas.





Tierschutzverordnung
(TSchV)

8. Abschnitt: Hauskaninchen

Art. 64 Beschäftigung sowie Gruppenhaltung für Jungtiere

[1] Kaninchen müssen täglich mit grob strukturiertem Futter wie Heu oder Stroh versorgt werden sowie ständig Objekte zum Benagen zur Verfügung haben.

Tierschutzverordnung
(TSchV)

Gehege für Säugetiere			Für Gruppen bis zu n Tieren					Für jedes weitere Tier[a)]		Besondere Anforderungen
			Anzahl	Aussengehege[a)]		Innengehege[a)]		Aussen	Innen	
Tierarten			(n)	Fläche[b)] m²	Volumen m³	Fläche[b)] m²	Volumen m³	m²	m²	
40	Meerschweinchen, *Cavia porcellus*	d)f)g)	2	–	–	0,5	–	–	0,2	39) 41) 45) 47) 54)
41	Hamster, Mesocricetus sp.	d)	1	–	–	0,18	–	–	0,05	2) 40) 41) 42) 44) 45) 48)
42	Maus, Mus musculus	d)	2	–	–	0,18	–	–	0,05	2) 39) 41) 42) 44) 45) 47)
43	Mongolische Rennmaus (Gerbil)	d)	5	–	–	0,5	–	–	0,05	40) 41) 42) 44) 45) 46) 47)
44	Ratte, Rattus norvegicus	d)	5	–	–	0,5	0,35	–	0,05	39) 41) 42) 44) 45) 47)
45	Degu		5	–	–	0,5	0,35	–	0,2	40) 41) 45) 46) 47)
46	Chinchilla	d)	2	–	–	0,5	0,75	–	0,2	39) 41) 42) 43) 45) 46) 47)

44) Grob strukturiertes Futter, wie Heu oder Stroh; für Hamster und Mäuse Körnerbeimischungen; für Meerschweinchen Vitamin-C-haltiges Futter.

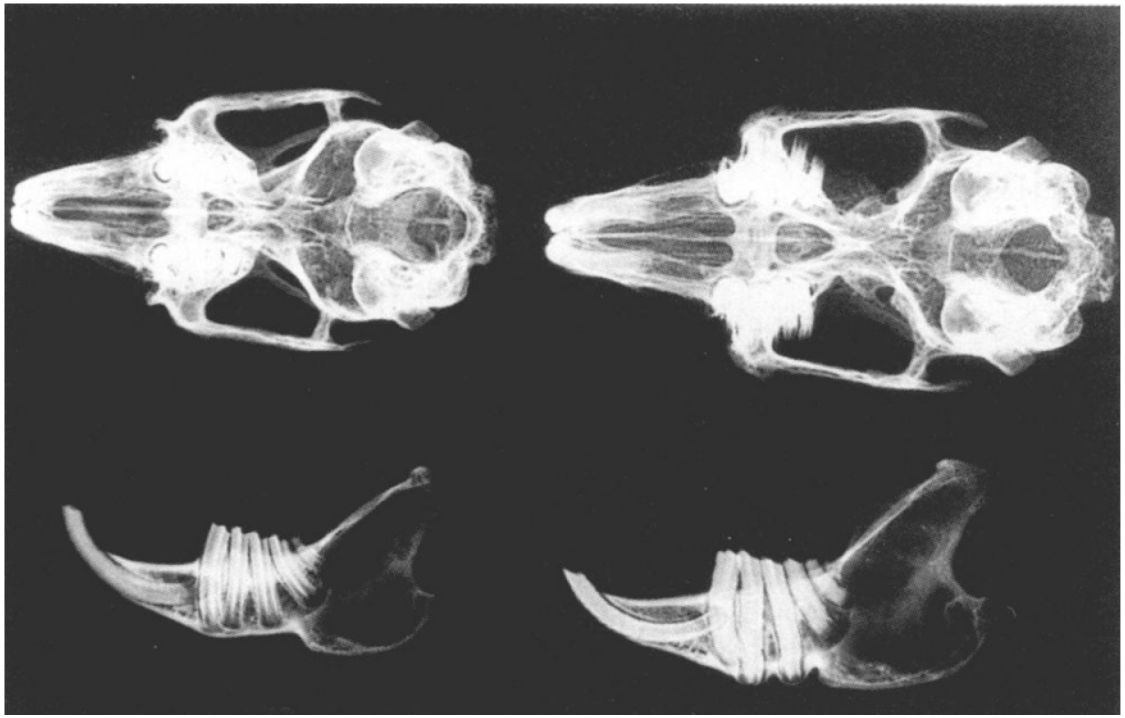
45) Nageobjekte, wie Weichholz oder frische Äste.

Mögliche Ursachen: Mineralstoff-Mangel?

Calcium deficiency, diet and dental disease in pet rabbits

F. M. Harcourt-Brown

Veterinary Record (1996) **139,** 567-571



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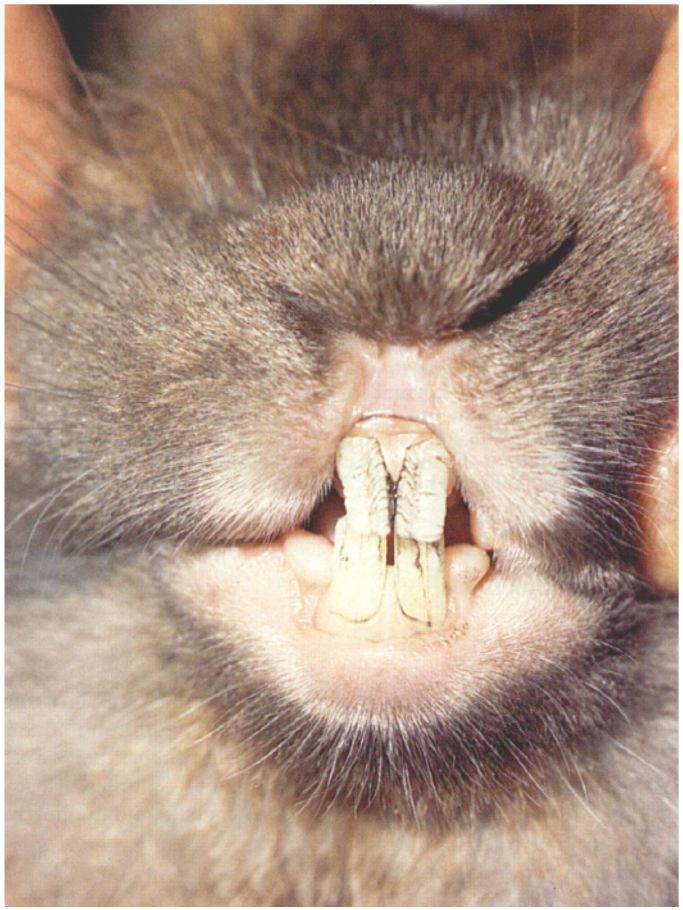

Calcium deficiency, diet and dental disease in pet rabbits

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Veterinary Record (1996) **139,** 567-571

Impact of pelleted diets with different mineral compositions on the crown size of mandibular cheek teeth and mandibular relative density in degus (*Octodon degus*)

V. Jekl, M. Gumpenberger, E. Jeklova, K. Hauptman, L. Stehlik, Z. Knotek

Veterinary Record (2011) 168, 641

TABLE 1: Mineral dietary content and access to UV light in four groups of degus (*Octodon degus*)

Group	Diet	Dietary calcium:phosphorus	Access to UV light
A	Ca 13.2 g/kg, P 6.3 g/kg	2:1	Yes
B	Ca 13.2 g/kg, P 6.3 g/kg	2:1	No
C	Ca 9.1 g/kg, P 9.5 g/kg	1:1	Yes
D	Ca 9.1 g/kg, P 9.5 g/kg	1:1	No

Ca Calcium, P Phosphorous

Impact of pelleted diets with different mineral compositions on the crown size of mandibular cheek teeth and mandibular relative density in degus (*Octodon degus*)

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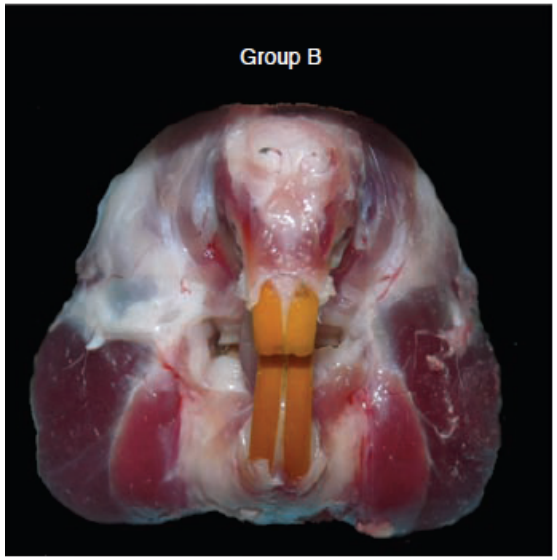

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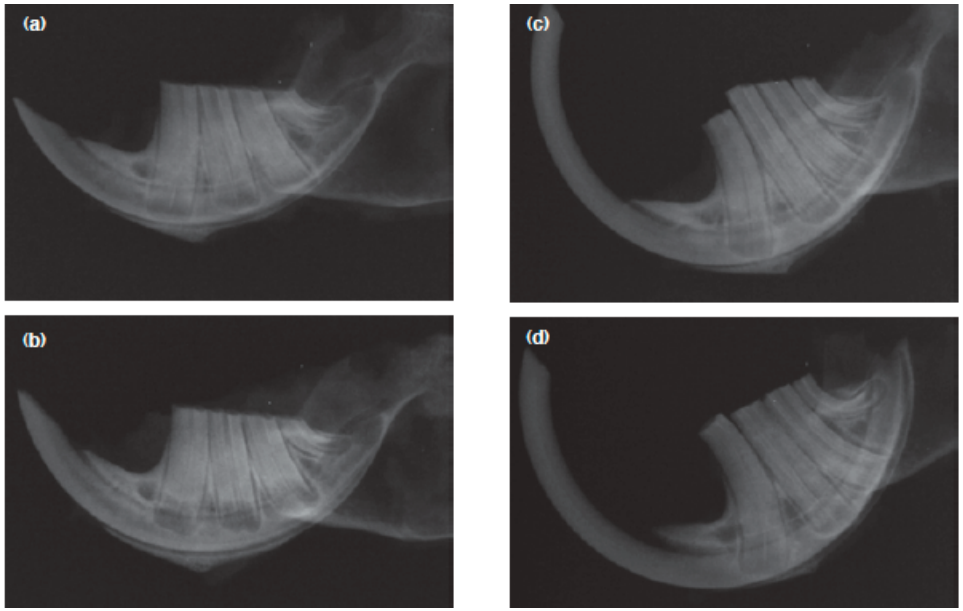


Survey of the husbandry, health and welfare of 102 pet rabbits

Veterinary Record (2006)
159, 103-109

S. M. Mullan, D. C. J. Main

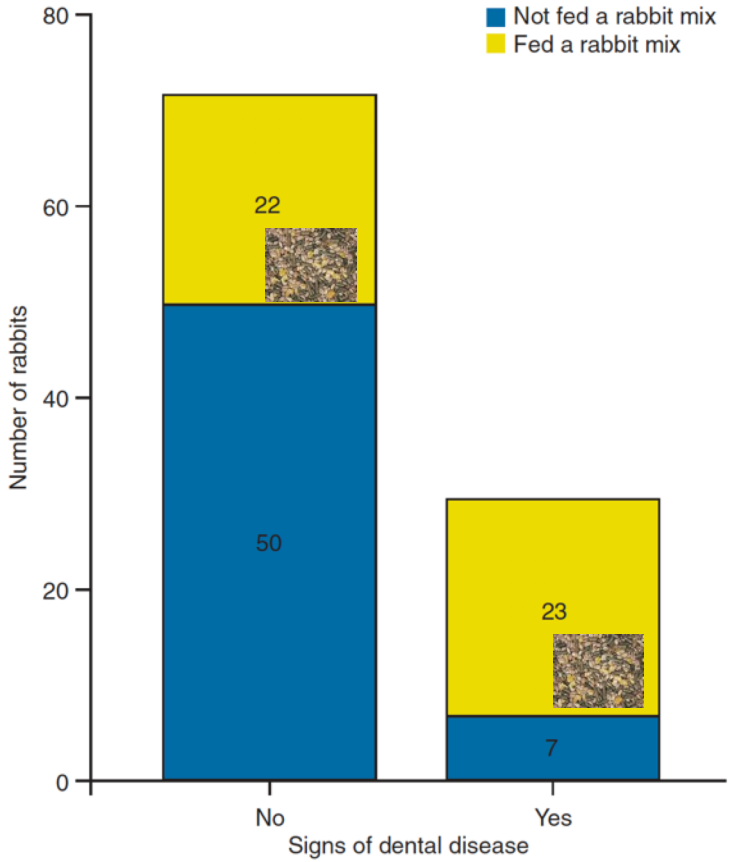
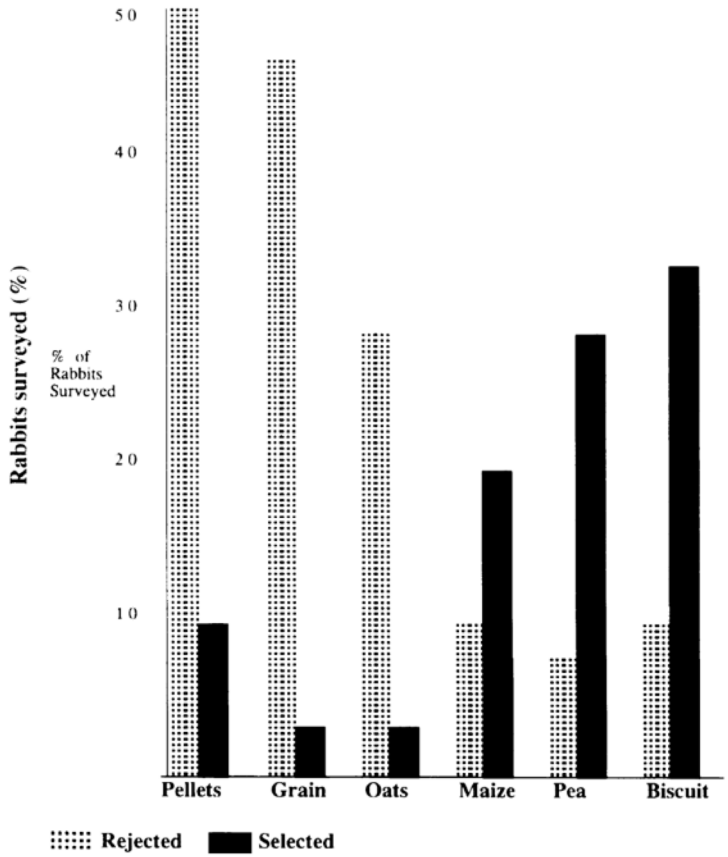


FIG 3: Association between the prevalence of dental disease in the 102 rabbits and feeding a rabbit mix

Calcium deficiency, diet and dental disease in pet rabbits

F. M. Harcourt-Brown

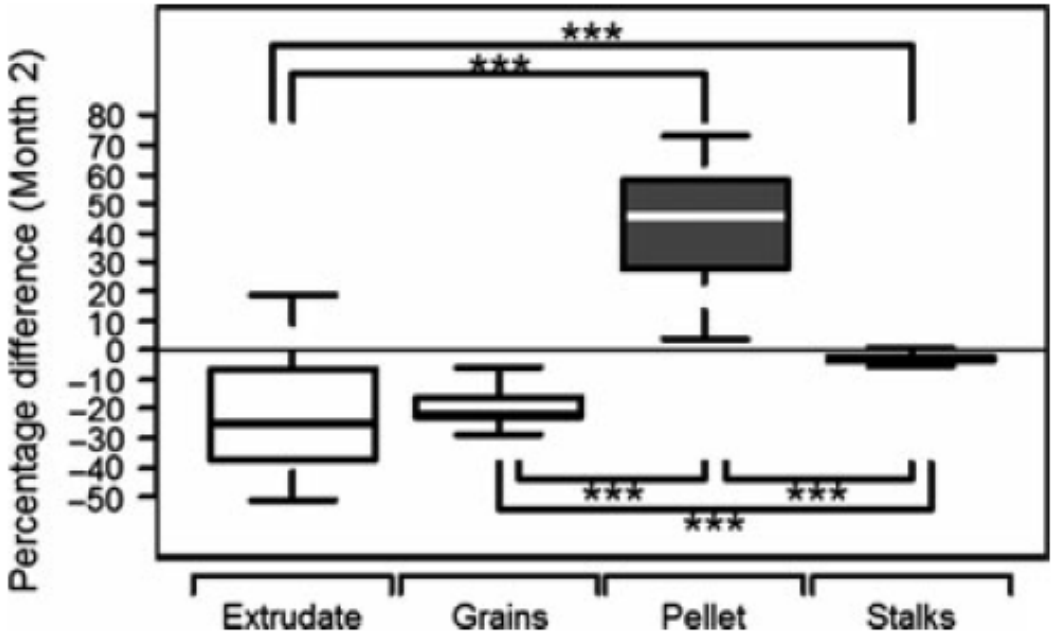
Veterinary Record (1996) **139,** 567-571



Food and water intake and selective feeding in rabbits on four feeding regimes

J. L. Prebble* and A. L. Meredith

Journal of Animal Physiology and Animal Nutrition **98** (2014) 991–1000



Difference in composition between offering and leftovers

Prevalence of dental disorders in degus and evaluation of diagnostic methods to determine dental disease and its prognosis

Hester van Bolhuis,[1] Lotte van Hoffen,[2] Martine van Zijll Langhout,[3] Heleen van Engeldorp Gastelaars,[3] Wouter Hendriks,[4,5,6] Marnix Lamberts,[7] Marja Kik[8]

Veterinary Record (2017) doi: 10.1136/vr.104253

Calcium and phosphorus analysis

There was no significant difference in mean Ca:P between the control group and the group with dental disorders (1.86±0.01; mean±SEM) (F=1.379, P=0.100) (Table 3). Additionally, the mean Ca content and the mean P content did not differ between the two groups (F=0.655, P=0.489 and F=0.586, P=0.586).

Mineralstoff-Mangel

Unausgeglichenes Ca:P – Verhältnis
Absoluter Mangel an Ca oder P

… können Zahnprobleme auslösen

… müssen aber nicht die Ursache sein

Eine Fütterung, die …

- *Hauptsächlich Heu- bzw. Gras-basiert ist*

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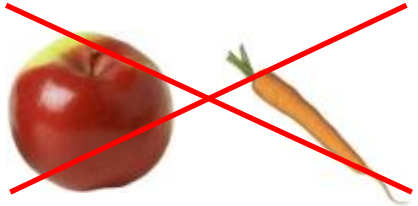

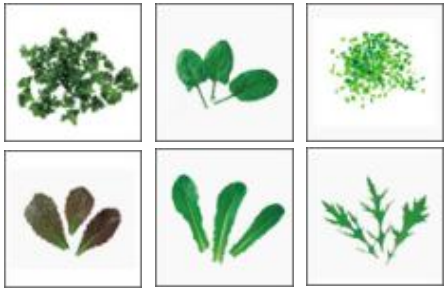

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… ist auf der sicheren Seite.

Mögliche Ursachen: ungenügender Zahnabrieb?

Wie wir es früher gelehrt haben …

"Zahnwachstum ist konstant …

Wachstum (mm/Woche) der Schneidezähne

Spezies	Unterkiefer	Oberkiefer
Ratte	1,8-3,9	1,5-2,6
Chinchilla	1,1-2,2	1,3-1,7
Meerschweinchen	1,2-1,9	1,4-1,7
(Zwerg-) Kaninchen	1,1-1,8	1,3-1,7

Kamphues (2001)

… und muss durch Kauen eines geeigneten Futters durch Abrieb ausgeglichen warden."

Wie wir es früher gelehrt haben …

"Zahnwachstum ist konstant …

benötigte Zeit für Futteraufnahme (min/g Trockensubstanz)

Futter	Zwergkaninchen	Meerschw.	Chinchilla
Grasheu	5-12	8-14	14-20
Frisches Gras	7	7	19
‚Müsli‘	3	4	5
Pellets	1	5	4

Wenger (1997), Schröder (1999)

… und muss durch Kauen eines geeigneten Futters durch Abrieb ausgeglichen warden."

Ungenügender Zahnabrieb

Kann zu wenig Zahnabrieb Zahnprobleme auslösen?

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Eine Haltung, die …

- *ausreichend Nagematerial anbietet*

Ungenügender Zahnabrieb

Kann zu wenig Zahnabrieb Zahnprobleme auslösen?

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Eine Haltung, die …

- *ausreichend Nagematerial anbietet*

… ist auf der sicheren Seite.

Zahnabrieb und Zahnwachstum: Grundlagen

Frage

Wie beeinflusst die Nahrung, insbesondere ihre Abrasivität, den Zahnabrieb und das Wachstum?

RESEARCH ARTICLE

Growth and Wear of Incisor and Cheek Teeth in Domestic Rabbits (*Oryctolagus cuniculus*) Fed Diets of Different Abrasiveness

JOURNAL OF EXPERIMENTAL ZOOLOGY
PART A
ECOLOGICAL GENETICS AND PHYSIOLOGY
A Journal of Integrative Biology

JACQUELINE MÜLLER[1], MARCUS CLAUSS[1]*, DARYL CODRON[1,2], ELLEN SCHULZ[3], JÜRGEN HUMMEL[4], MIKAEL FORTELIUS[5], PATRICK KIRCHER[6], AND JEAN-MICHEL HATT[1]

[1]Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Zurich, Switzerland
[2]Florisbad Quaternary Research, National Museum, Bloemfontein, South Africa
[3]Biocenter Grindel and Zoological Museum, University of Hamburg, Hamburg, Germany
[4]Department of Animal Sciences, Ruminant Nutrition, Georg-August University, Göttingen, Germany
[5]Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland
[6]Division of Diagnostic Imaging, Vetsuisse Faculty, University of Zurich, Zurich, Switzerland

ABSTRACT

Although patterns of tooth wear are crucial in palaeo-reconstructions, and dental wear abnormalities are important in veterinary medicine, experimental investigations on the relationship between diet abrasiveness and tooth wear are rare. Here, we investigated the effect of four different pelleted diets of increasing abrasiveness (due to both internal [phytoliths] and external abrasives [sand]) or whole grass hay fed for 2 weeks each in random order to 16 rabbits (*Oryctolagus cuniculus*) on incisor and premolar growth and wear, and incisor and cheek tooth length. Wear and tooth length differed between diets, with significant effects of both internal and external abrasives. While diet abrasiveness was linked to tooth length for all tooth positions, whole forage had an additional effect on upper incisor length only. Tooth growth was strongly related to tooth wear and differed correspondingly between diets and tooth positions. At 1.4–3.2 mm/week, the growth of cheek teeth measured in this study was higher than previously reported for rabbits. Dental abnormalities were most distinct on the diet with sand. This study demonstrates that concepts of constant tooth growth in rabbits requiring consistent wear are inappropriate, and that diet form (whole vs. pelleted) does not necessarily affect cheek teeth. Irrespective of the strong effect of external abrasives, internal abrasives have the potential to induce wear and hence exert selective pressure in evolution. Detailed differences in wear effects between tooth positions allow inferences about the mastication process. Elucidating feedback mechanisms that link growth to tooth-specific wear represents a promising area of future research. *J. Exp. Zool. 321A:283–298, 2014.* © 2014 Wiley Periodicals, Inc.

J. Exp. Zool. 321A:283–298, 2014

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DOI: 10.1111/jpn.12226

ORIGINAL ARTICLE

Tooth length and incisal wear and growth in guinea pigs (*Cavia porcellus*) fed diets of different abrasiveness

J. Müller[1], M. Clauss[1], D. Codron[1,2], E. Schulz[3,4], J. Hummel[5], P. Kircher[6] and J.-M. Hatt[1]

1 Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Zurich, Switzerland
2 Florisbad Quaternary Research, National Museum, Bloemfontein, South Africa
3 Biocenter Grindel and Zoological Museum, University of Hamburg Hamburg, Germany
4 Max Planck Weizmann Center for Integrative Archaeology and Anthropology, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany
5 Department of Animal Sciences, Ruminant Nutrition, Georg-August University, Göttingen, Germany, and
6 Division of Diagnostic Imaging, Vetsuisse Faculty, University of Zurich, Zurich, Switzerland

Summary

Dental diseases are among the most important reasons for presenting guinea pigs (*Cavia porcellus*) and other rodents to veterinary clinics, but the aetiopathology of this disease complex is unclear. Clinicians tend to believe that the ever-growing teeth of rabbits and rodents have a constant growth that needs to be worn down by the mastication of an appropriate diet. In this study, we tested the effect of four different pelleted diets of increasing abrasiveness [due to both internal (phytoliths) and external abrasives (sand)] or whole grass hay fed for 2 weeks each in random order to 16 guinea pigs on incisor growth and wear, and tooth length of incisors and cheek teeth. There was a positive correlation between wear and growth of incisors. Tooth lengths depended both on internal and external abrasives, but only upper incisors were additionally affected by the feeding of whole hay. Diet effects were most prominent in anterior cheek teeth, in particular M1 and m1. Cheek tooth angle did not become shallower with decreasing diet abrasiveness, suggesting that a lack of dietary abrasiveness does not cause the typical 'bridge formation' of anterior cheek teeth frequently observed in guinea pigs. The findings suggest that other factors than diet abrasiveness, such as mineral imbalances and in particular hereditary malocclusion, are more likely causes for dental problems observed in this species.

Keywords veterinary dentistry, tooth wear, tooth growth, phytolith, attrition, abrasion

Correspondence M. Clauss, Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Winterthurerstr. 260, 8057 Zurich, Switzerland. Tel: +41 44 635 83 76; Fax: ++41 44 635 8901; E-mail: mclauss@vetclinics.uzh.ch

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Introduction

The teeth of extant caviomorph rodents are open rooted and continuously growing (hypselodont). This characteristic feature is an adaptation to ensure continuous tooth function in the presence of abrasion (Ungar, 2010). In healthy animals, tooth growth ('eruption') and wear of dental tissue are well balanced, leading to a normal tooth shape and length. Tooth wear can be induced either by tooth-on-tooth contact (i.e. attrition) or by tooth-on-food contact (i.e. abrasion); food may contain internal abrasives, such as phytoliths, or external abrasives, such as grit or dust (Butler, 1972; Fortelius, 1985; Kaiser et al., 2013). Any process interfering with either normal growth or wear of dental tissue will result in dental disease.

One of the most important disease complexes in guinea pigs and other rodents is dental abnormalities, and 12% (Langenecker et al., 2009) to 23.4% (Jekl et al., 2008) of guinea pigs presented in veterinary clinics are diagnosed with dental disease. Rodents suffering from dental disease show a variety of clinical signs such as weight loss, chewing problems or a tendency to eat softer food, ptyalism (a condition formerly known as 'slobbers', Pollock, 1951) followed by hair loss around the chin, poor fur quality and decreased grooming, facial swellings or abscesses, ocular discharge due to obstruction or inflammation of the nasolacrimal duct, dysphagia, inability to carry out coprophagy and fewer or smaller faecal pellets (Verstraete, 2003; Osofsky and Verstraete, 2006; Harcourt-Brown, 2007; Meredith, 2007).

The aetiology of this disease complex is still unclear, and causes are frequently divided into congenital and acquired (Lennox, 2008). Congenital causes are considered rare in rodents, but are often diagnosed in

Eingesetzte Futter

Table 1. Composition of different complete pelleted diets (lucerne L, grass G, grass and rice hulls GR, grass and rice hulls and sands GRS) and grass hay (H).

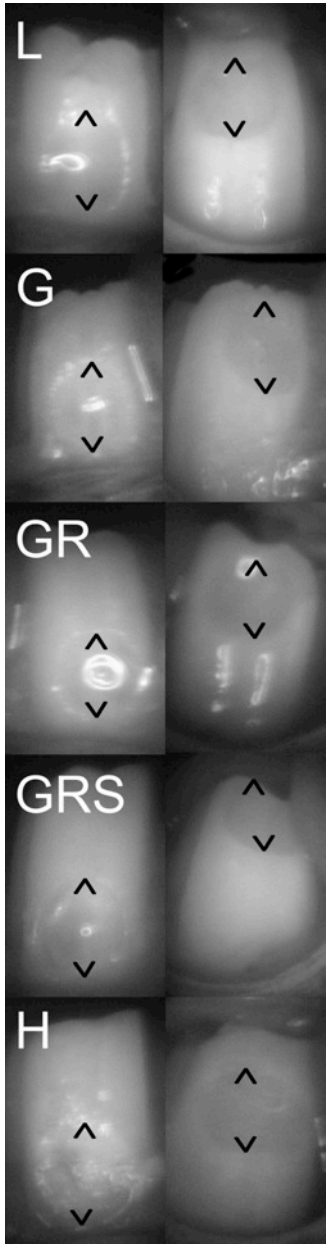
	L	G	GR	GRS	H
Ingredients					
Lucerne meal (%)	60.0	–	–	–	–
Grass meal (%)	–	60.0	64.8	64.8	–
Rice hulls (%)	–	–	20.0	20.0	–
Sand[a] (%)	–	–	–	5.0	–
Pure lignocellulose (%)	33.8	27.4	5.0	–	–
Soybean meal (%)	–	7.0	5.0	5.0	–
Molasses (%)	3.0	3.0	3.0	3.0	–
Lignobond (%)	2.0	2.0	2.0	2.0	–
Soy oil (%)	1.0	0.4	–	–	–
Mineral/vitamin premix (%)	0.2	0.2	0.2	0.2	–
Dry matter (% as fed)	91.4	91.9	91.8	92.2	90.8
Nutrient composition (g/kg DM)					
Total ash	79	64	75	130	104
Crude protein	102	90	97	85	109
aNDFom[b]	578	600	487	459	579
ADFom[c]	434	403	322	299	354
ADL[d]	131	110	74	65	52
ADIA[e]	05	16	24	77	38
Dry matter digestibility (%)	39.7 ± 9.3	34.3 ± 8.1	41.2 ± 5.7	40.7 ± 11.1	45.1 ± 4.1

[a]Sand for playgrounds, grain size 0–1 mm, REDSUN garden products B.V., Heijen, Denmark; mean particle size measured by sieve analysis as dMEAN (Fritz et al., 2012) of 0.233 mm.
[b]aNDFom neutral detergent fiber, determined using amylase and ash
[c]ADFom acid detergent fiber, ash corrected.
[d]ADL acid detergent lignin ash corrected.
[e]ADIA acid detergent insoluble ash (a measure for abrasives).

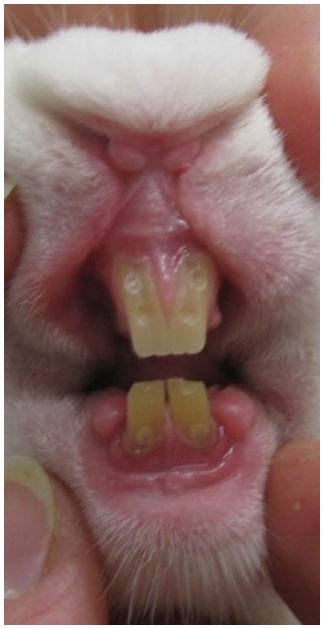
Methode

16 Tiere, 5 Futter, jedes Futter für 2 Wochen gefüttert

Bohrmarkierungen auf Schneidezähnen und am ersten unteren Backenzahn (Kaninchen)

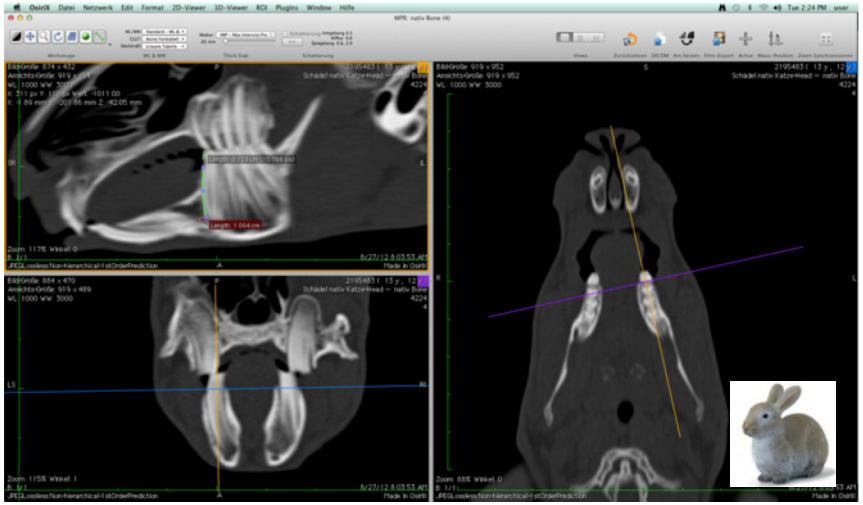


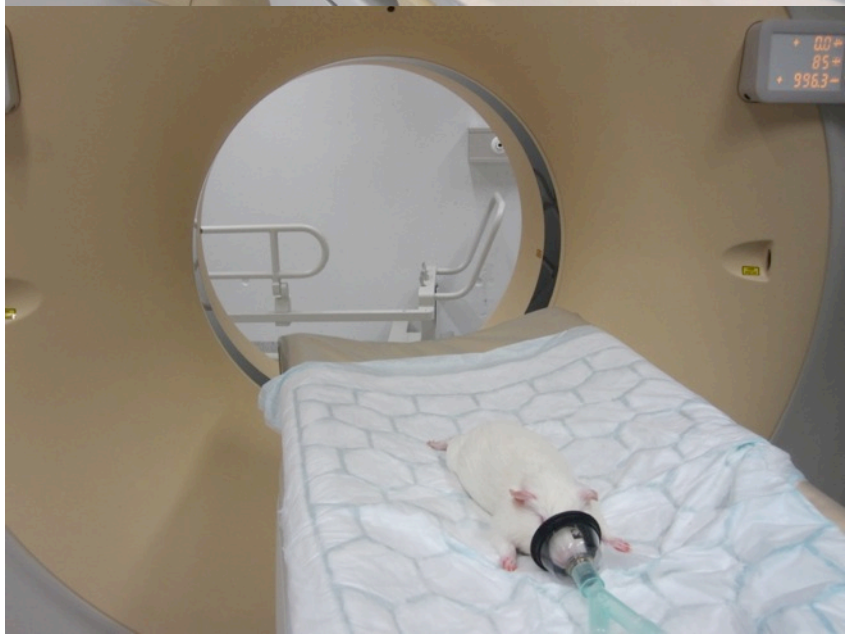
Kaninchen

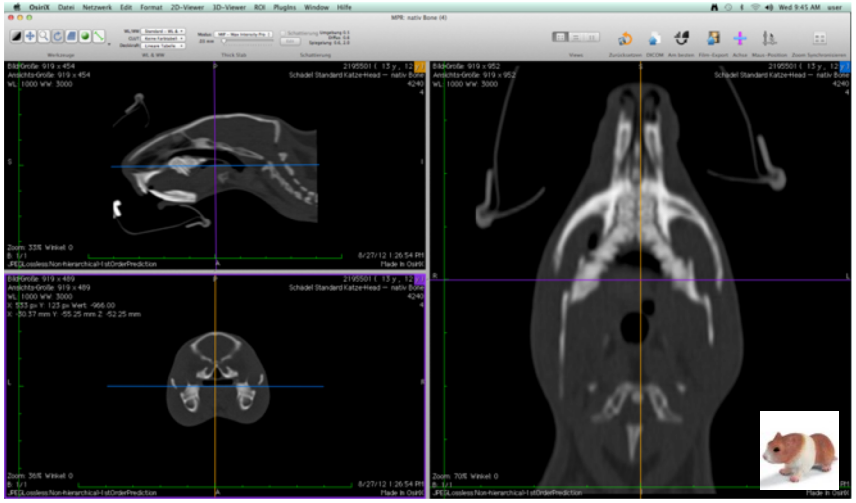


Meerschweinchen

Computertomographie







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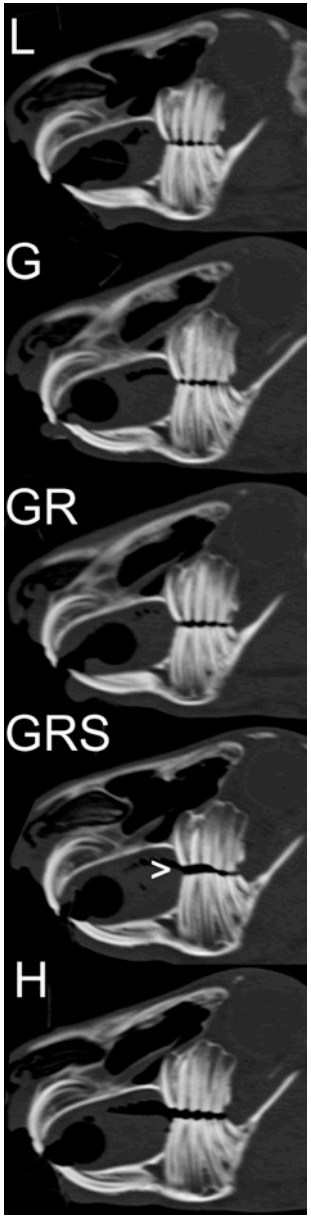
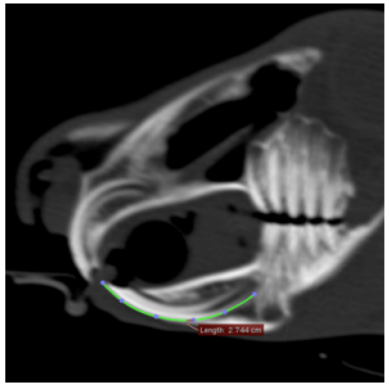
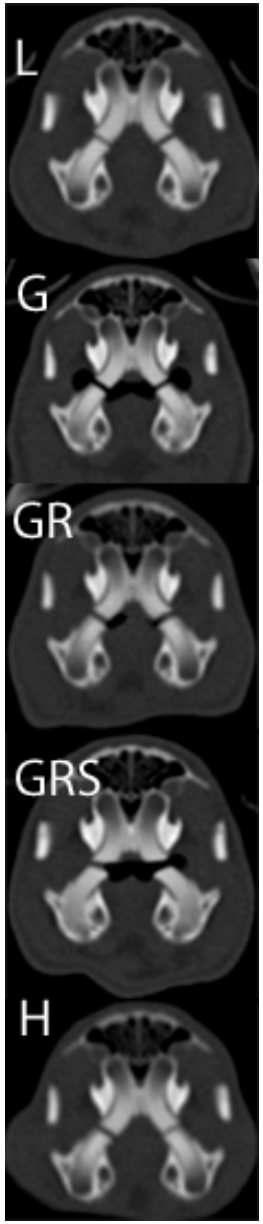
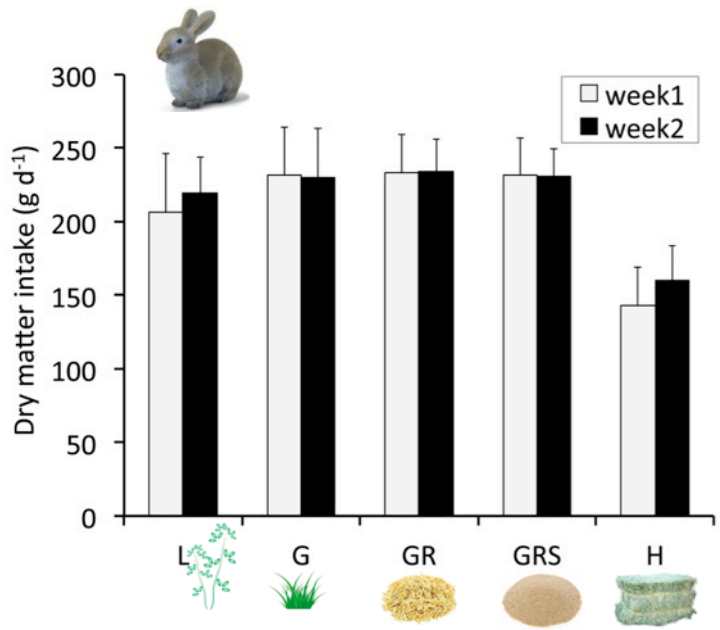
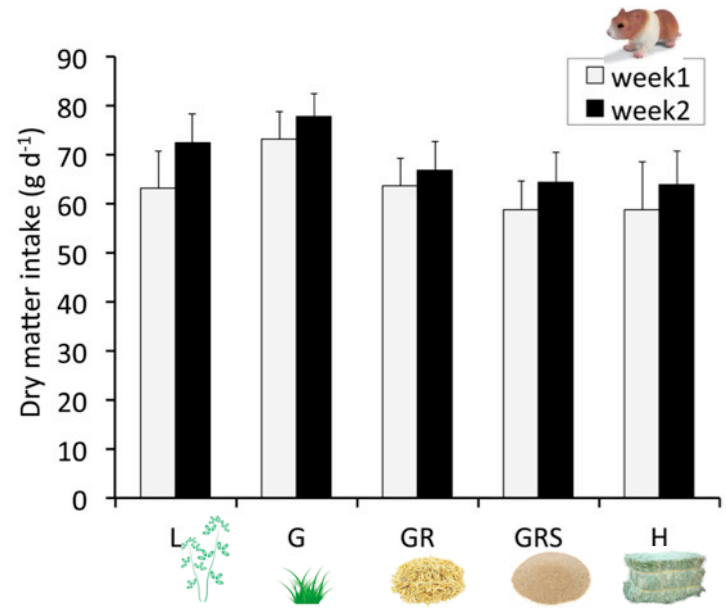


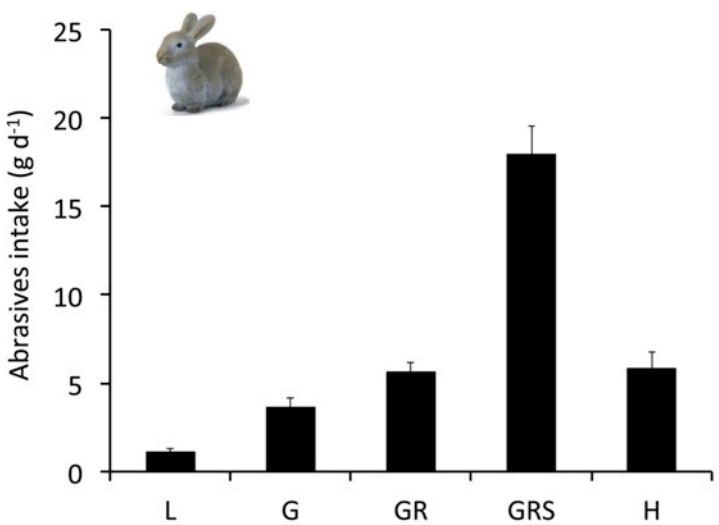


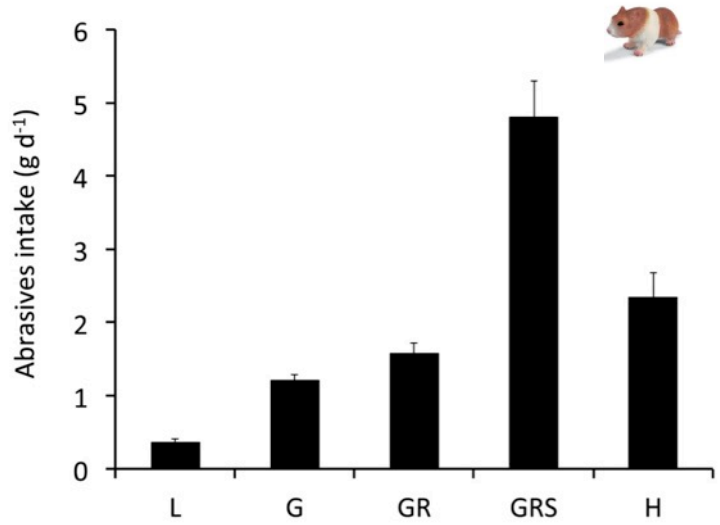


Futter- und Silikat-Aufnahme

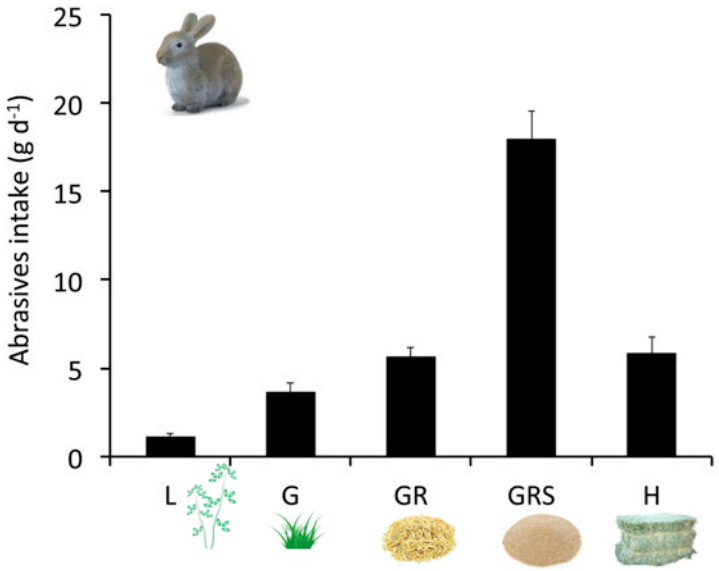


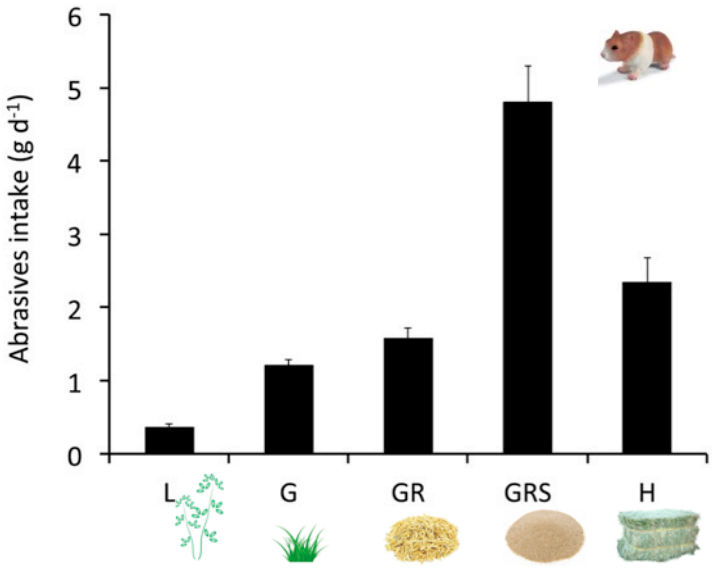


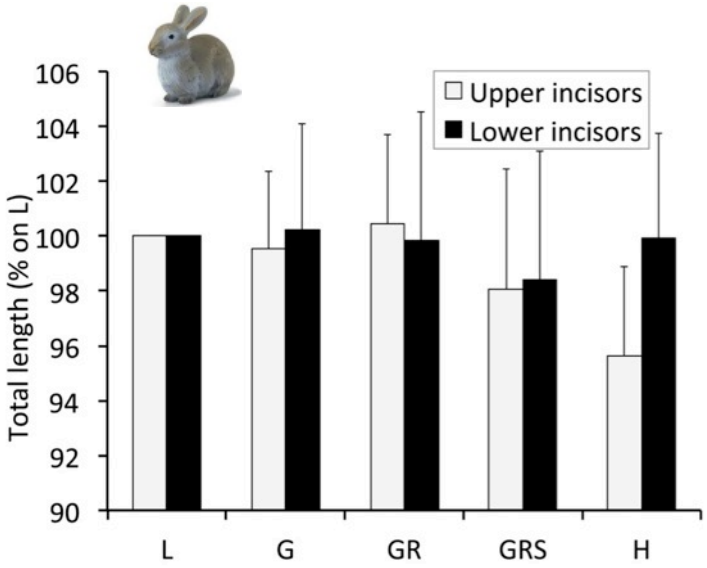


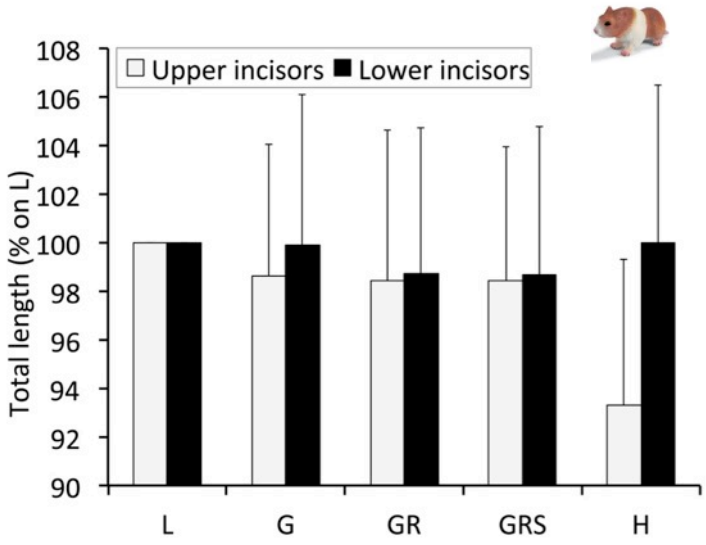


Schneidezahn-Länge

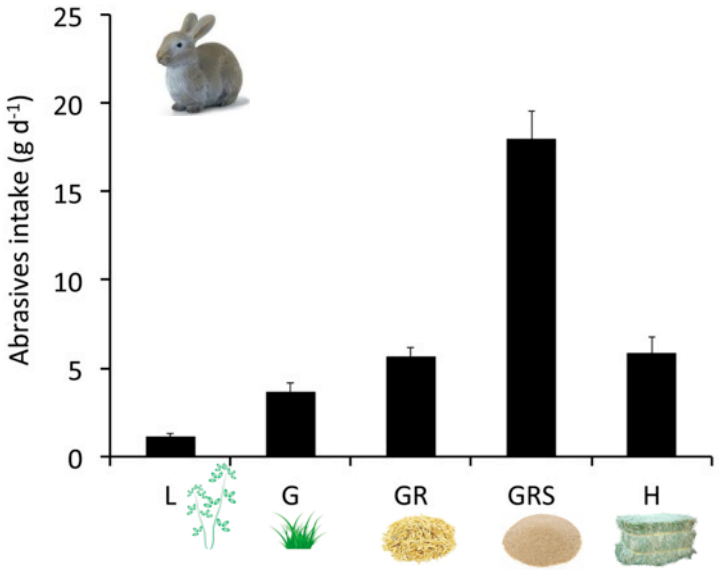


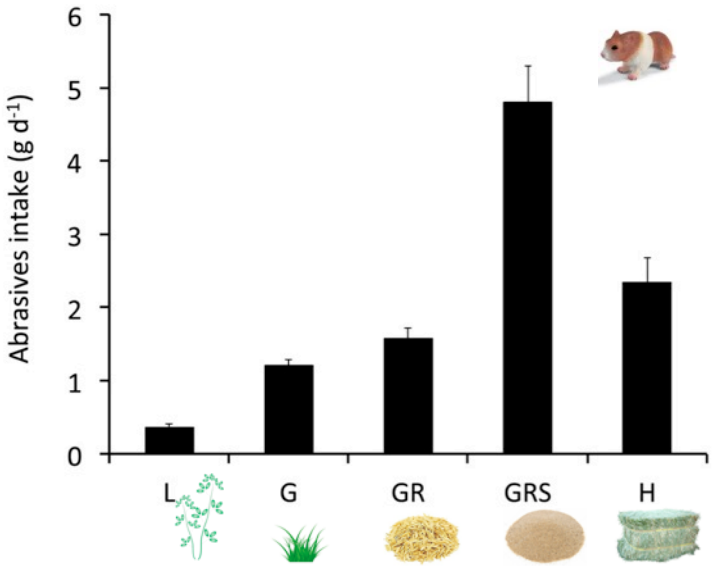


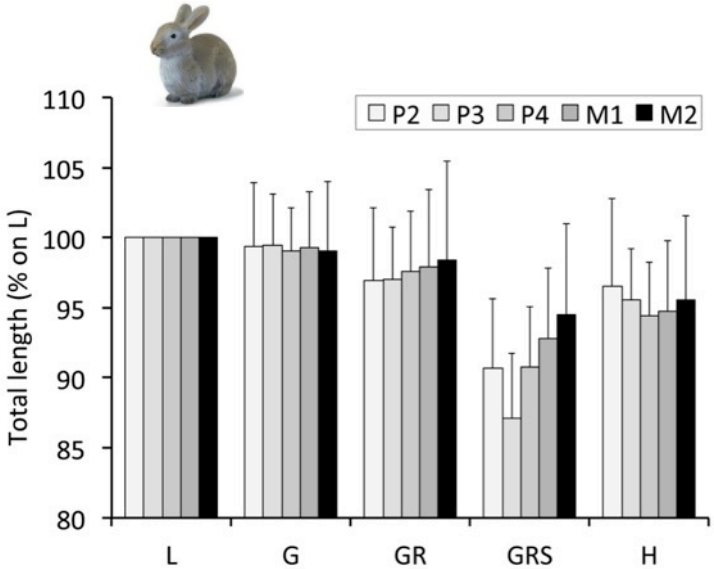


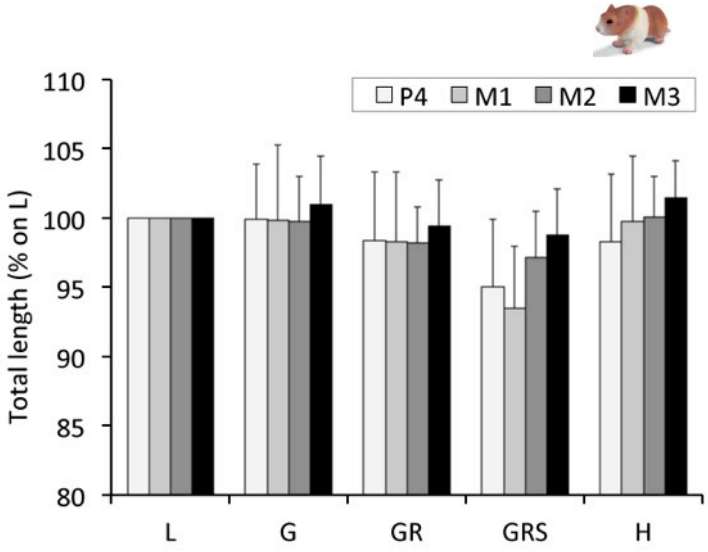


Oberkiefer-Backenzahn-Höhe









Impact of diet on incisor growth and attrition and the development of dental disease in pet rabbits

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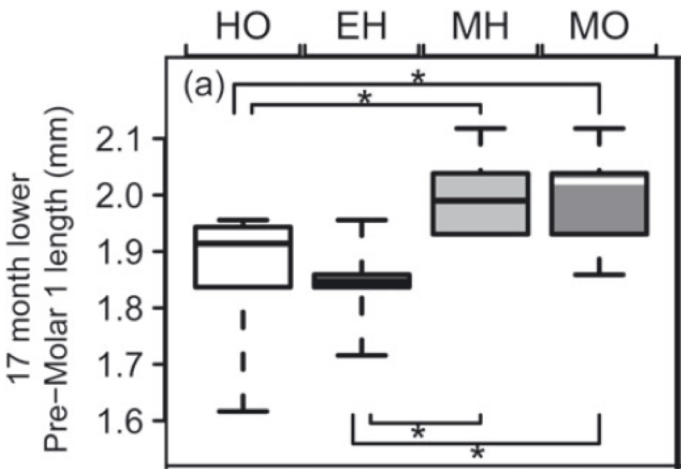
Journal of Small Animal Practice (2015) **56**, 377–382

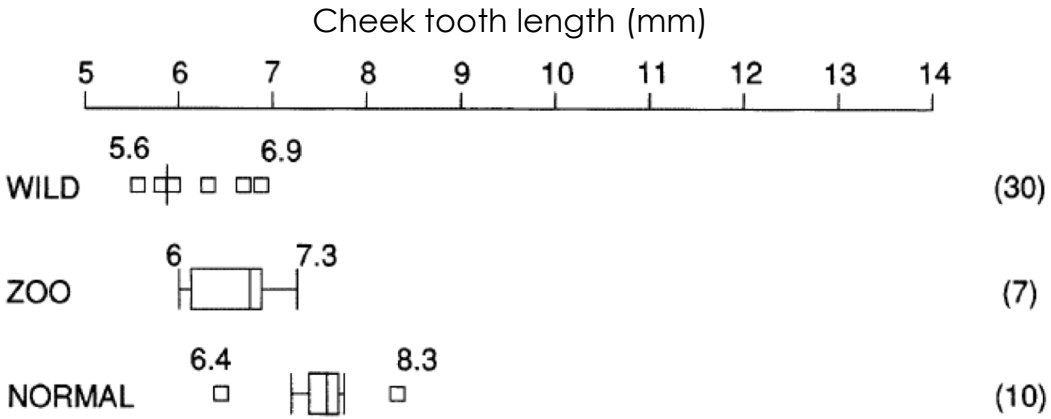
Unterer Backenzahn



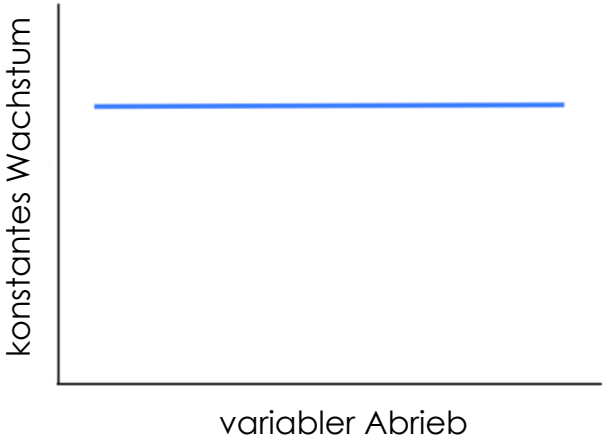
Skull size and cheek-tooth length in wild-caught and captive-bred chinchillas

David A. Crossley *, Maria del Mar Miguélez

Archives of Oral Biology 46 (2001) 919–928



Wachstum



Wie wir es früher gelehrt haben …

"Zahnwachstum ist konstant …

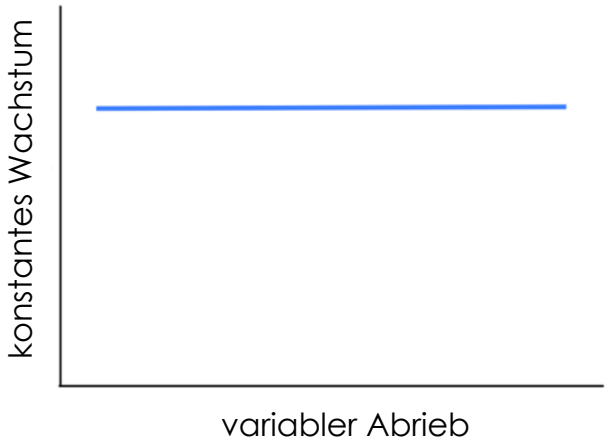
Wachstum (mm/Woche) der Schneidezähne

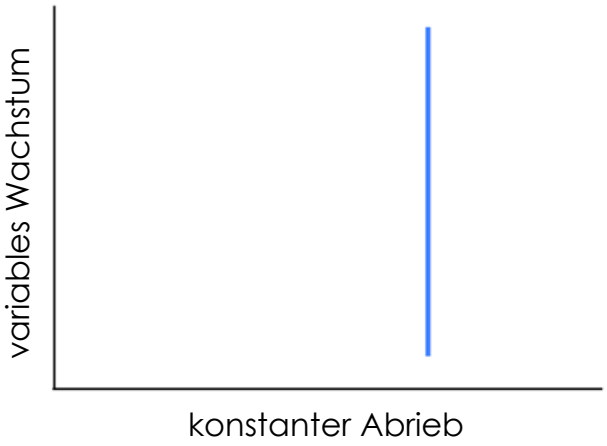
Spezies	Unterkiefer	Oberkiefer
Ratte	1,8-3,9	1,5-2,6
Chinchilla	1,1-2,2	1,3-1,7
Meerschweinchen	1,2-1,9	1,4-1,7
(Zwerg-) Kaninchen	1,1-1,8	1,3-1,7

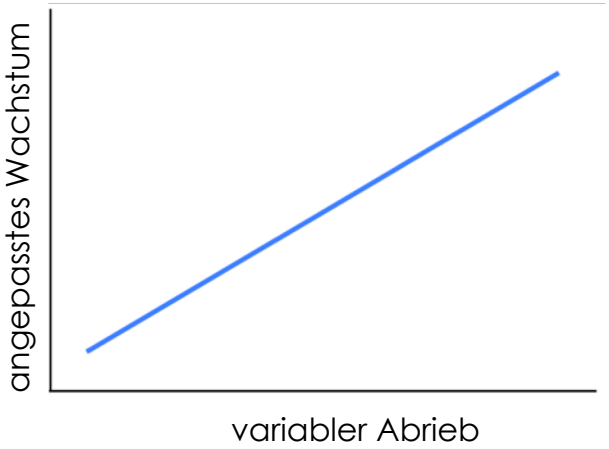
Kamphues (2001)

… und muss durch Kauen eines geeigneten Futters durch Abrieb ausgeglichen warden."

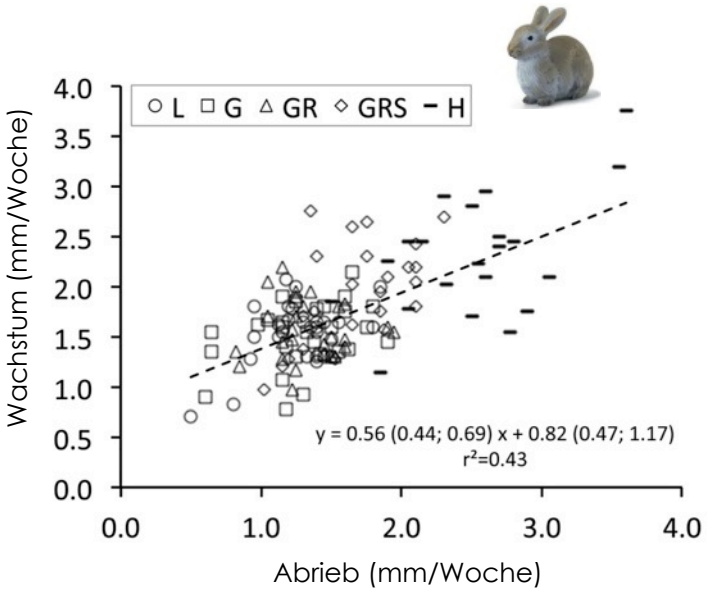
Wachstum

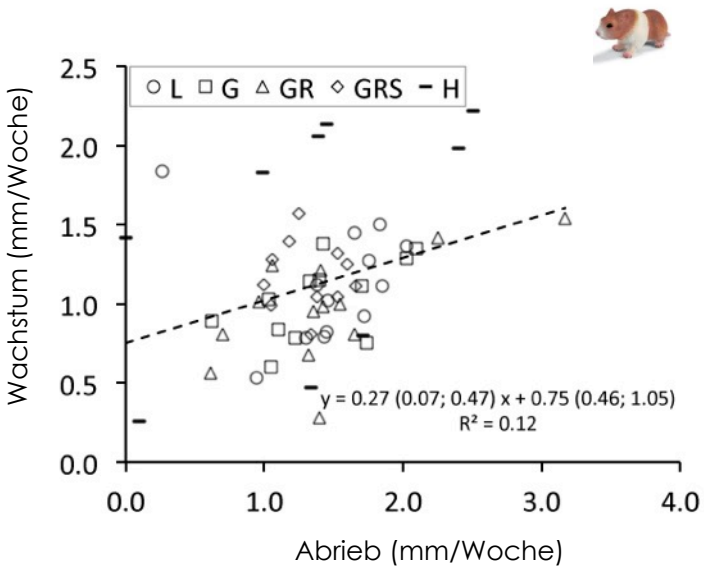

konstantes Wachstum
variabler Abrieb

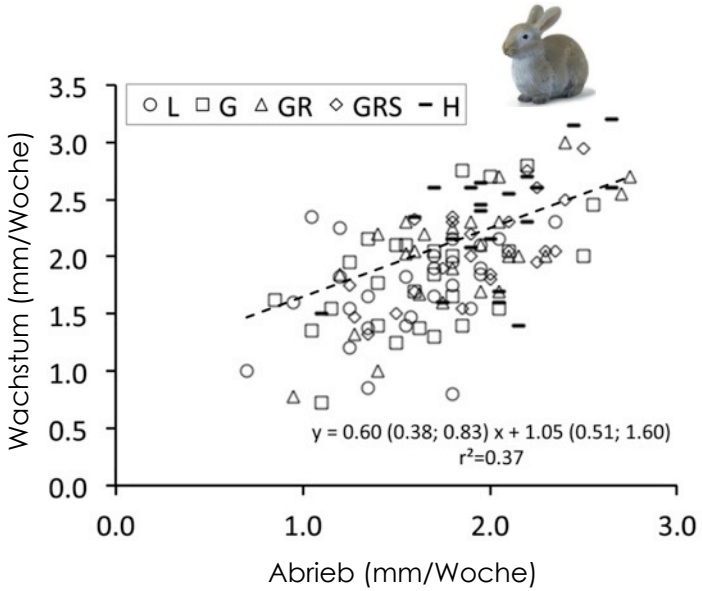

variables Wachstum
konstanter Abrieb

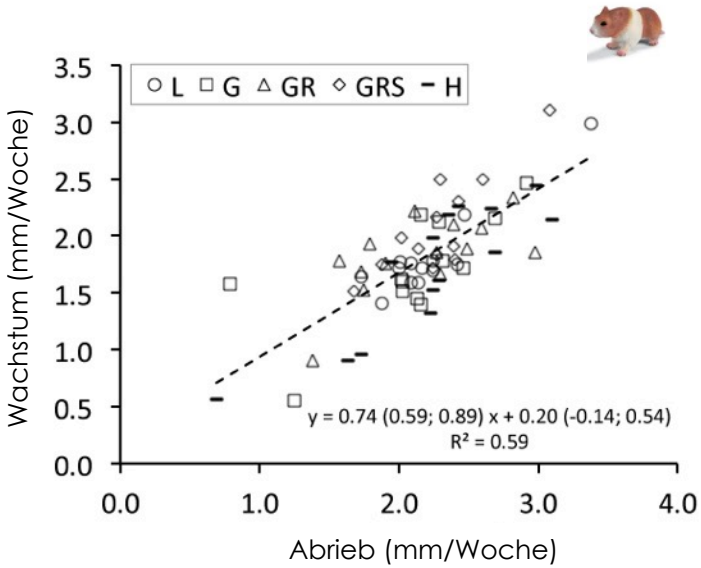

angepasstes Wachstum
variabler Abrieb

Wachstum oberer/unterer Schneidezahn









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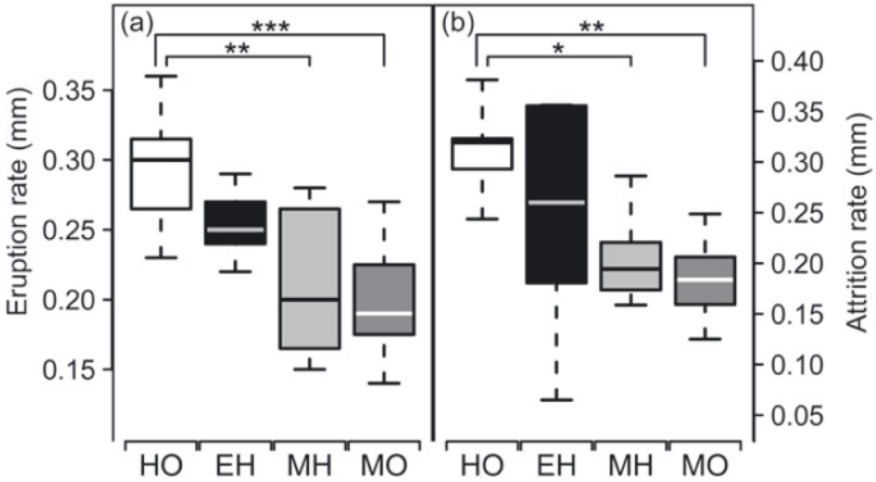
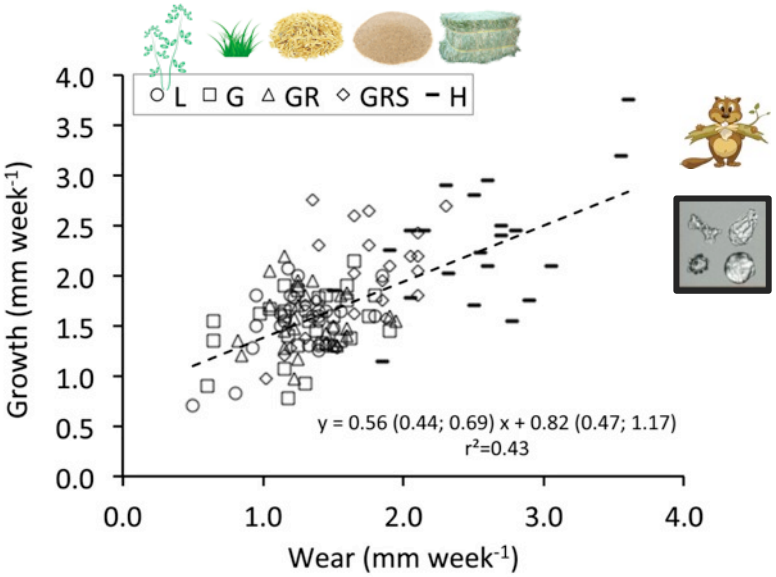
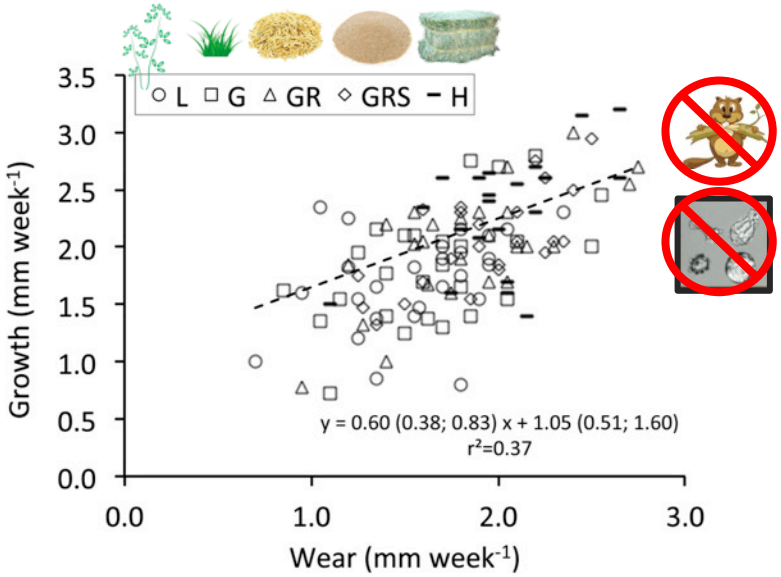
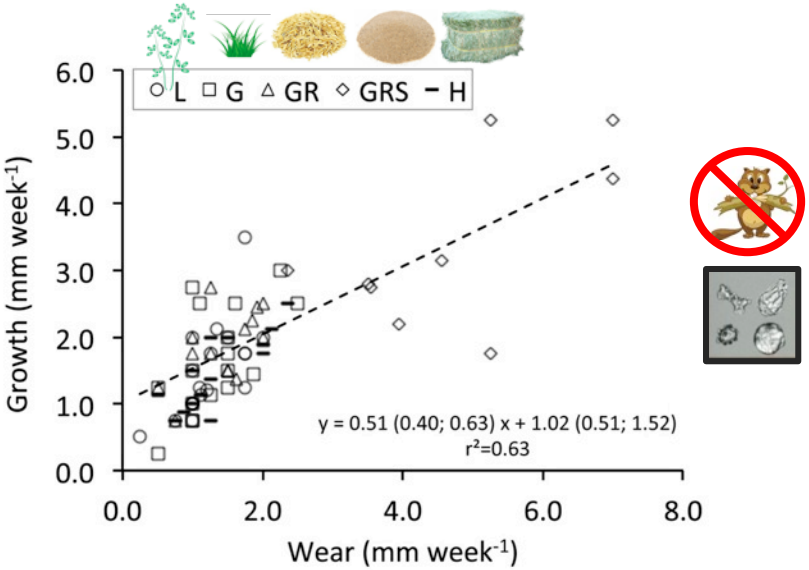
Schneidezähne



Schneidezahn-Backenzahn-Wachstum







Ungenügender Zahnabrieb

Kann zu wenig Zahnabrieb Zahnprobleme auslösen?
=> *Vermutlich nicht, weil das Zahnwachstum auf den Abrieb reagiert, und zwar Einzelzahn-spezifisch.*

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Vol 48, No 1
February 1998

Effects of Feeding a Liquid Diet for One Year to New Zealand White Rabbits

Mickey A. Latour,[1*] Dan Hopkins,[2] Tom Kitchens,[3] Zhouji Chen,[3] and Gustav Schonfeld[3]

The purpose of the study reported here was to compare the long-term (1-year) effects of feeding a newly designed liquid diet with feeding of a well-established commercially available dry diet.

Table 1. Nutritional composition of liquid and control diets

	Diet	
Nutrient (%)	Liquid	Control
Protein	21.5	14.5
Fat	7.2	2.2
Crude fiber	4.4	21.1
Ash	4.3	8.9
Moisture	8.0	10.0
Nitrogen-free extract	54.6	43.3

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Effects of Feeding a Liquid Diet for One Year to New Zealand White Rabbits

Mickey A. Latour,[1*] Dan Hopkins,[2] Tom Kitchens,[3] Zhouji Chen,[3] and Gustav Schonfeld[3]

After the 52-week trial, there were no visual signs of lesions in the aorta or digestive tract, and hepatic enzyme activities were normal.

Mickey Latour, pers. comm. 24.02.2017 to MC:
"We did not have any issues with teeth."

Ungenügender Zahnabrieb

Kann zu wenig Zahnabrieb Zahnprobleme auslösen?
=> *Vermutlich nicht, weil das Zahnwachstum auf den Abrieb reagiert, und zwar Einzelzahn-spezifisch.*

Eine Fütterung, die …

- *Hauptsächlich Heu- bzw. Grasbasiert ist*
- *als Ergänzungsfutter keine klassichen Müsli-Mischungen sondern Futter mit gleichmässigem Mineralgehalt aller Komponenten nutzt*
- *kein Obst oder buntes Gemüse einsetzt*

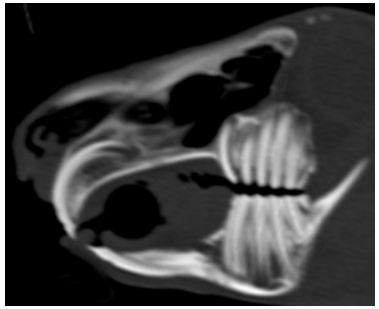
Eine Haltung, die …

- *ausreichend Nagematerial anbietet*

… ist auf der sicheren Seite.

Mögliche Ursachen: Futter-Typ ?

Wellengebiss



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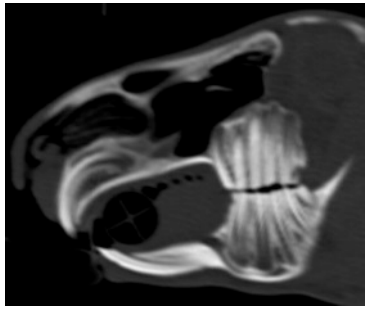

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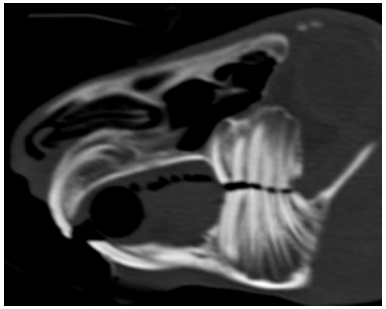

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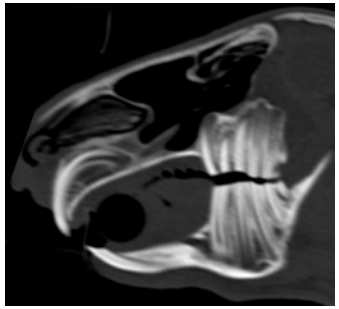

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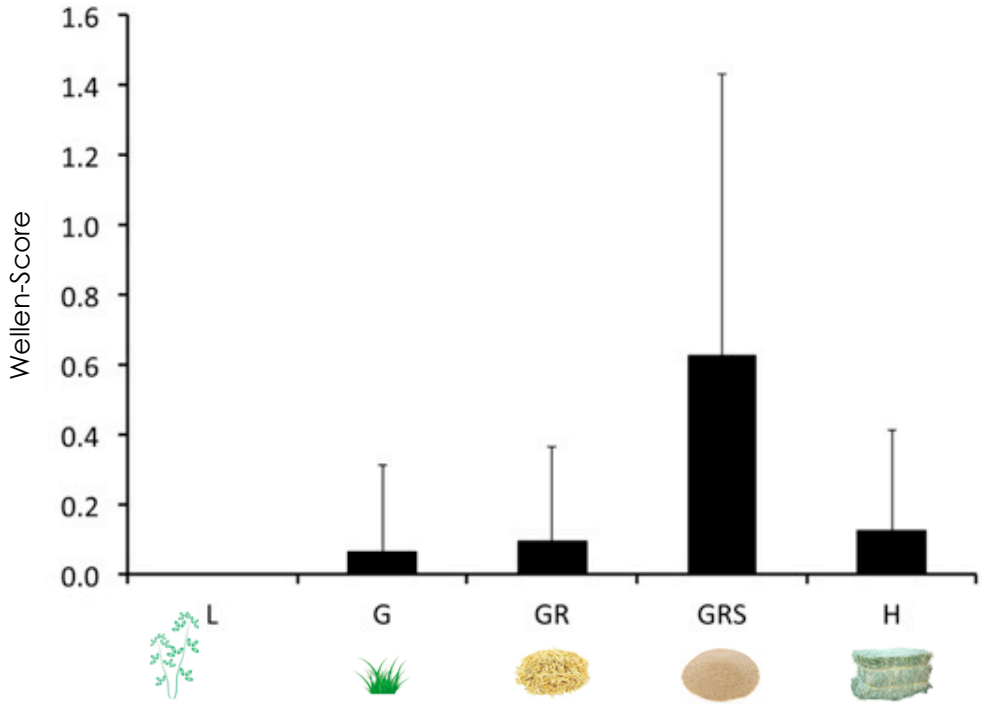
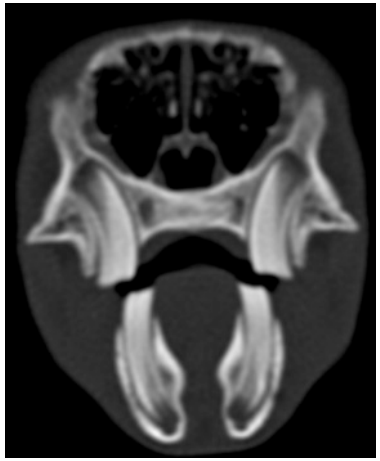


Zahnspitzen



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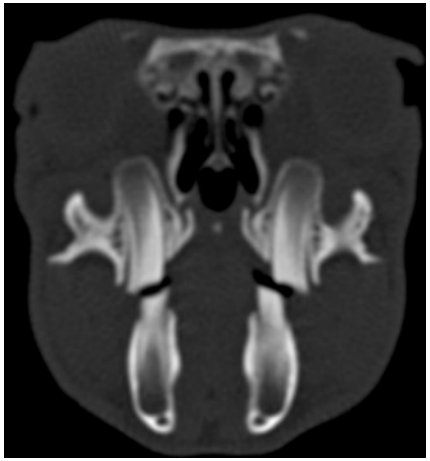

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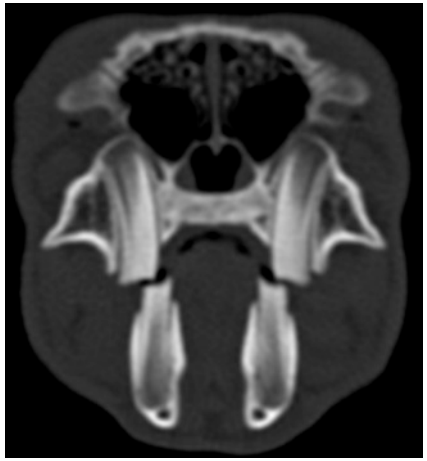

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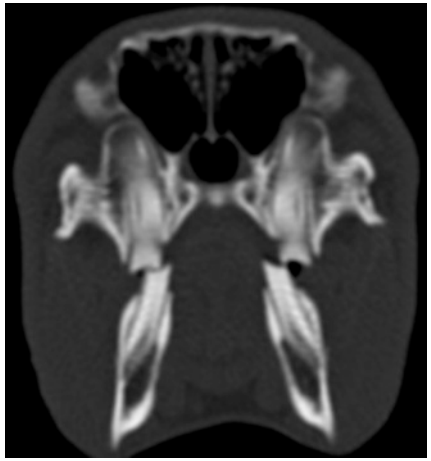

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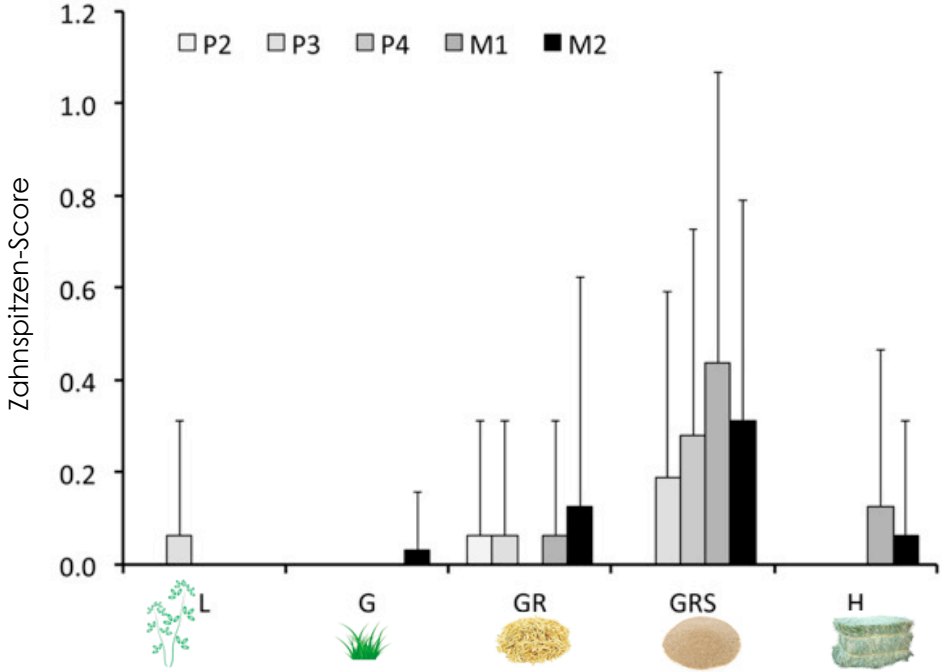
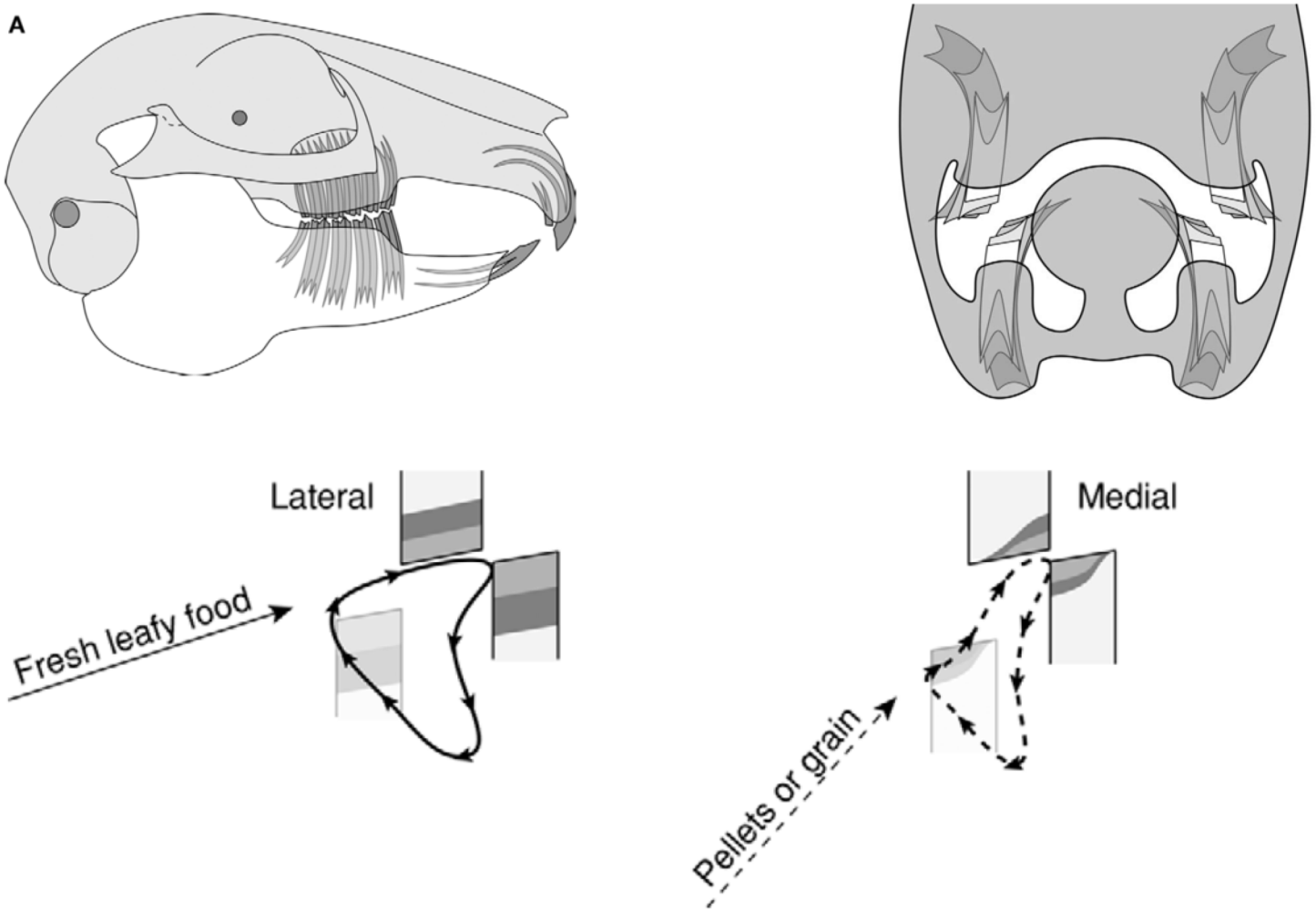


Oral biology and disorders of lagomorphs

David A. Crossley, B Vet Med, FAVD, DipEVDC*

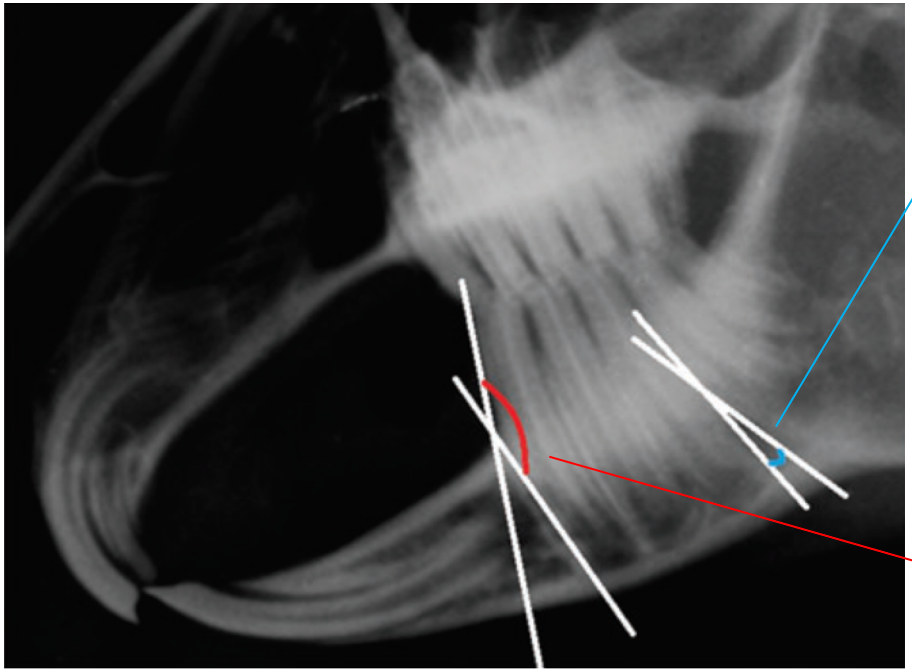
Vet Clin Exot Anim 6 (2003) 629–659



Impact of diet on incisor growth and attrition and the development of dental disease in pet rabbits

A. L. Meredith, J. L. Prebble and D. J. Shaw

Journal of Small Animal Practice (2015) **56**, 377–382



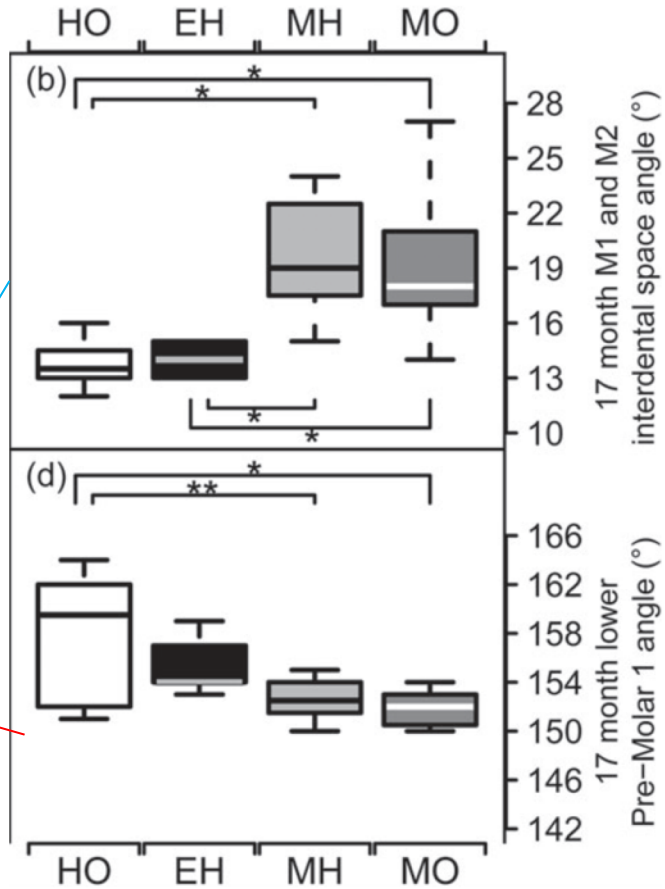


Table 3. Calcium and phosphorus content in the diets consumed taking into account selective feeding

	HO	EH	MH	MO
Calcium (%)	0·28	0·39	0·52	0·60
Phosphorus (%)	0·17	0·28	0·24	0·27
Ca:P Ratio	1·65:1	1·40:1	2·22:1	2·25:1

Verändertes Kauverhalten

Können bestimmte Futter über ein anderes Kauverhalten Zahnprobleme auslösen?
=> *Plausible Erklärung, genaue Untersuchungen fehlen.*

Eine Fütterung, die …

- *Hauptsächlich Heu- bzw. Grasbasiert ist*
- *als Ergänzungsfutter keine klassichen Müsli-Mischungen sondern Futter mit gleichmässigem Mineralgehalt aller Komponenten nutzt*
- *kein Obst oder buntes Gemüse einsetzt*

Eine Haltung, die …

- *ausreichend Nagematerial anbietet*

… ist auf der sicheren Seite.

Mögliche Ursachen: Was bleibt übrig ?

Genetik

Malocclusion in the Rabbit: A Model for the Study of the Development, Pathology and Inheritance of Malocclusion

I. Preliminary note

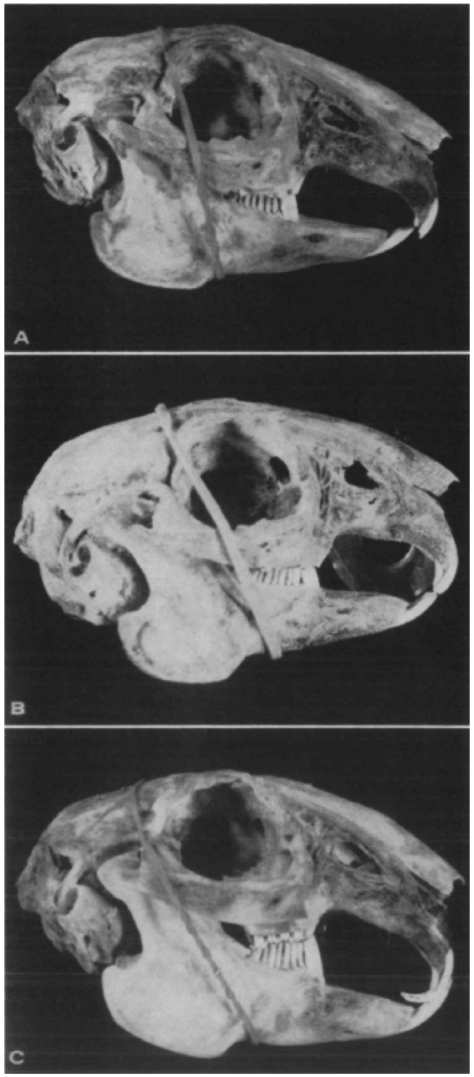
(1967) *58:* 245-6

STEVEN H. WEISBROTH AND LEE EHRMAN
The Journal of Heredity

MALOCCLUSION (long teeth, wolf teeth, walrus teeth) has long been recognized as a minor medical nuisance in the colony husbandry of rabbits. It is widely distributed as a seemingly spontaneous dental disease in most, if not all rabbit colonies. Many persons—trained investigators as well as laymen—have attributed this defect to genetic determination, although no documentation to the knowledge of the writers, has been offered to substantiate this claim[1, 2, 4]. One of the purposes of this communication is to ask the readers of this journal if they have knowledge either published or unpublished, or even casual observations that bear on the heritable nature of this condition. Exciting developments in

For these reasons, suggestions or comments by interested persons in the readership would be welcomed by the authors.

Mandibular Prognathism in the Rabbit



Genetic studies

(1971) 62: 23-27

R. R. Fox and D. D. Crary

The Journal of Heredity

Table I. The effect of mandibular prognathism (*mp/mp*) in the rabbit on maxilla and mandible length and height at age 3-3/4 months

	Normal (+/?) mean ± SE	With mandibular prognathism (*mp/mp*) mean ± SE	F†
Overall skull length (OL)	83.0 ± 0.560	80.6 ± 0.626	2.507
Nasal length (NL)	33.3 ± 0.346	33.9 ± 0.591	0.329
Maxilla tooth row (MXT)	15.0 ± 0.114	15.0 ± 0.321	0.004
Maxilla diastema (MXD)	24.4 ± 0.230	23.2 ± 0.239	4.131*
Anterior facial ht. (FHA)	12.6 ± 0.136	12.4 ± 0.008	0.465
Posterior facial ht. (FHP)	25.6 ± 0.158	25.0 ± 0.325	1.439
Mandible tooth row (MDT)	15.4 ± 0.131	15.5 ± 0.325	0.168
Mandible diastema (MDD)	18.7 ± 0.179	19.0 ± 0.330	0.394
Anterior mandible ht. (MDCHA)	5.0 ± 0.073	5.1 ± 0.277	0.682
Posterior mandible ht. (MDCHP)	13.8 ± 0.119	13.5 ± 0.229	0.758
OL/NL	2.50 ± 0.018	2.38 ± 0.037	5.128*
MXT/NL	0.453 ± 0.004	0.444 ± 0.012	0.534
MXD/NL	0.736 ± 0.007	0.684 ± 0.016	6.059*
FHA/NL	0.380 ± 0.003	0.367 ± 0.004	2.769
FHP/NL	0.769 ± 0.069	0.739 ± 0.091	2.437
MDT/NL	0.463 ± 0.005	0.460 ± 0.014	0.063
MDD/NL	0.562 ± 0.005	0.561 ± 0.014	0.000
MDCHA/NL	0.150 ± 0.001	0.152 ± 0.007	0.150
MDCHP/NL	0.415 ± 0.003	0.399 ± 0.009	3.940

† $N = 37$ normals, 5 prognathics. Measurement in millimeters were taken bilaterally for all except OL, NL, and MDCHA. These bilateral measurements were then averaged to give one value per rabbit.
* $P < 0.05$, all other $P > 0.05$

Simple autosomal recessive inheritance with incomplete penetrance is indicated and we propose the gene symbol *mp* for the gene responsible for this condition in the rabbit.

Genetic and environmental factors influencing tooth and jaw malformations in rabbits

A. K. Korn, H. R. Brandt, G. Erhardt

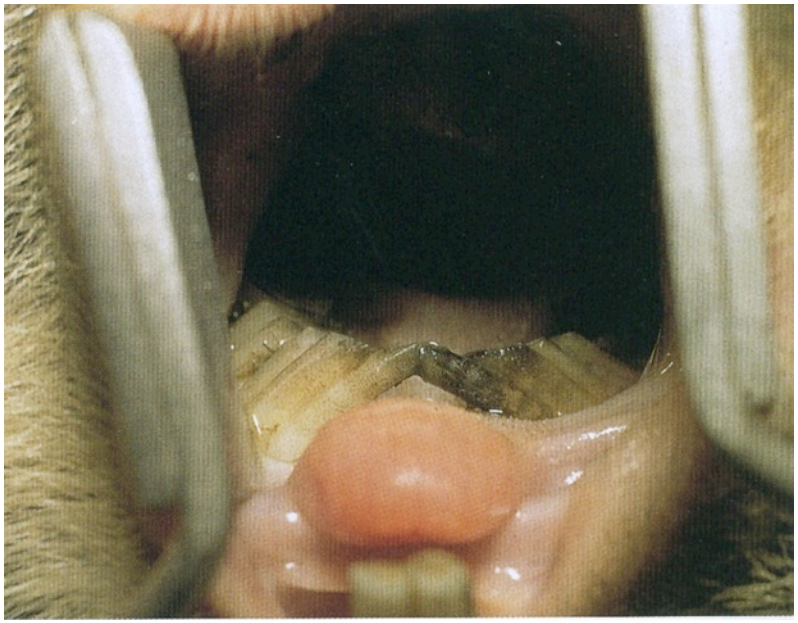
Veterinary Record (2016) doi: 10.1136/vr.103293

TABLE 5: Heritability and litter effects with ses for the three classifications of jaw and dental alterations: Brachygnathia superior, enamel defects and edge-to-edge bite

	Heritability	
Trait	All examinations (236 rabbits)	Last examination of each rabbit (197)
Brachygnathia superior	0.2538±0.1689	0.1053±0.0924
Enamel defects	0	0
Edge-to-edge bite	did not converge	

Considering this heritability, all fully grown rabbits showing this phenotype should be excluded from breeding.

Brückenbildung Meerschweinchen



Aus dem Institut für Zuchthygiene der Universität Zürich
(Direktor: Prof. Dr. K. Zerobin)
Abteilung Zoo-Heim-Versuchstiere (Leiter: Dr. E. Isenbügel)

MALOKKLUSION UND ZAHNÜBERWACHSTUM

Schädelmessungen bei

Cavia aperea f. porcellus Linnaeus, 1758

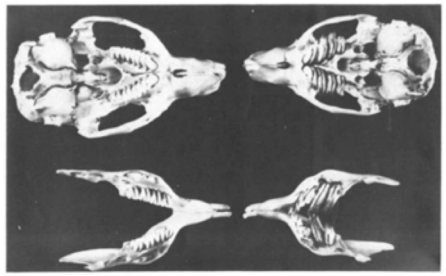
INAUGURAL—DISSERTATION
zur Erlangung der Doktorwürde
der Vet. Med. Fakultät der Universität Zürich

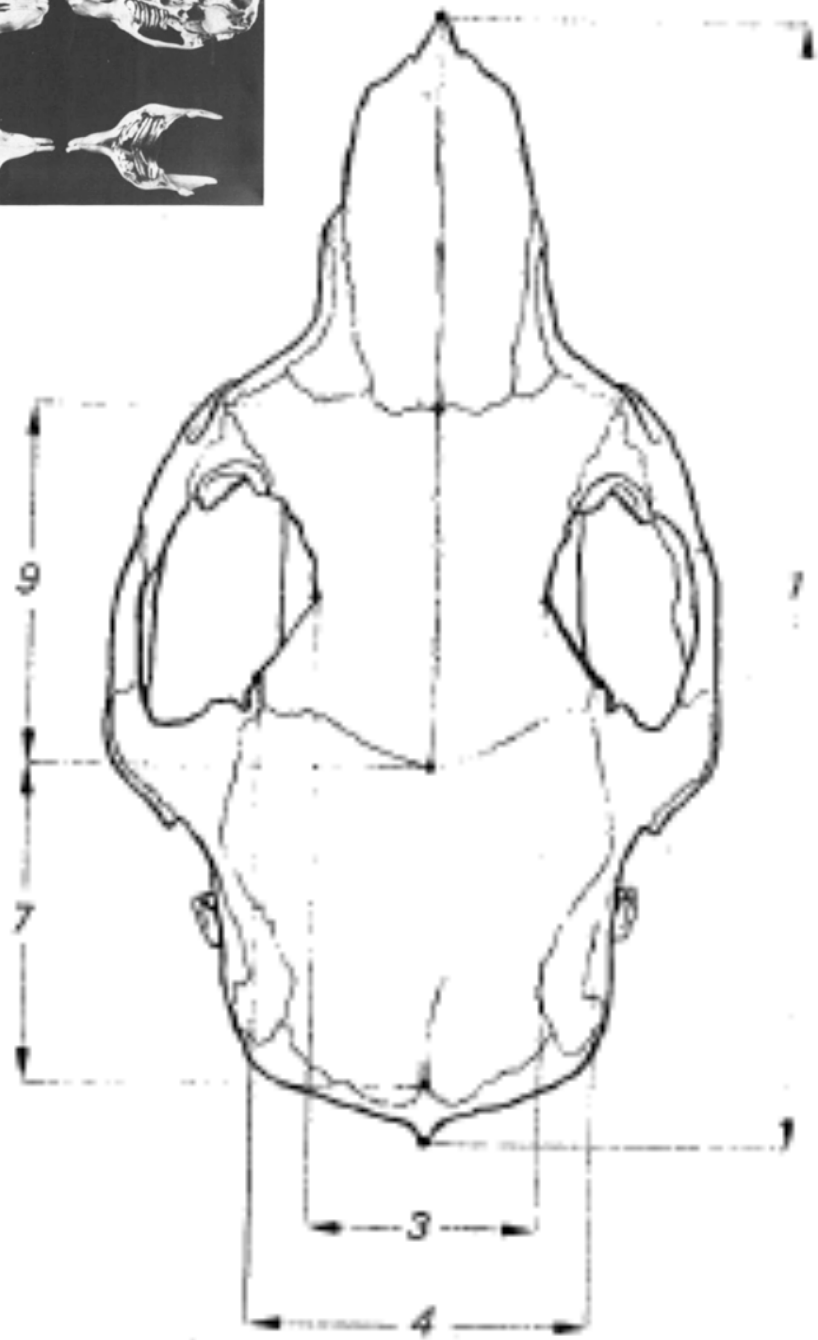
vorgelegt von

SILVIA STUDER
von Niederried/BE

Genehmigt auf Antrag von
Prof. Dr. H. U. Winzenried, Referent
Prof. Dr. J. Frewein, Korreferent

aku-Fotodruck
Zürich
1975

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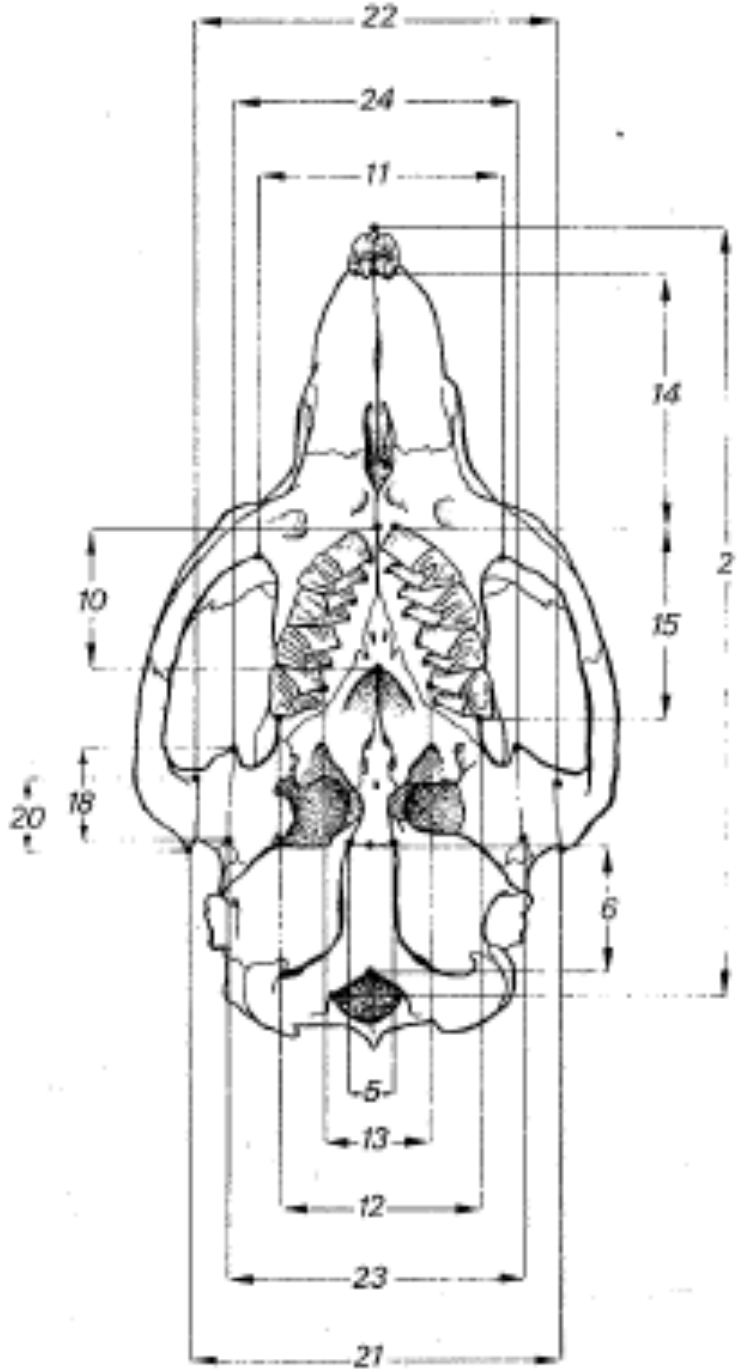
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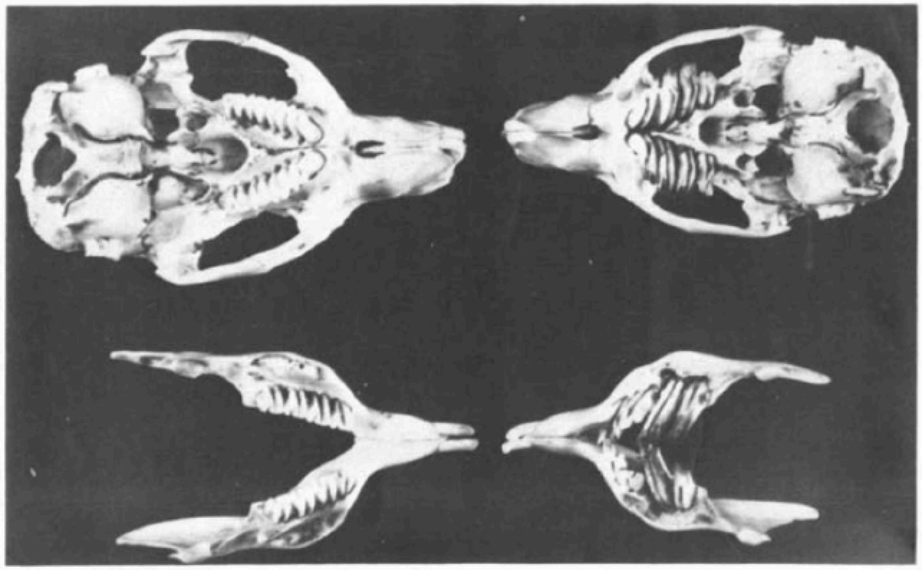
Malocclusion in inbred strain-2 weanling guineapigs

JOAN R. REST, TREVOR RICHARDS & SARAH E. BALL

Laboratory Animals (1982) 16, 84-87

The incidence of malocclusion was recorded for 4 years. The incidence was significantly reduced ($P > 0{\cdot}001$) by breeding from animals without affected siblings: it is suggested that malocclusion in this colony has a genetic basis.



EDITORIAL

Breeding for good dental and oral health in rabbits

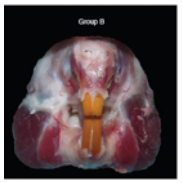
Ana Castejon

Veterinary Record | April 2, 2016

Zusammenfassung

Zahnprobleme können auch ausgelöst werden durch …

- Mineralstoff-Konzentration/Verhältnis



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- Mineralstoff-Konzentration/Verhältnis
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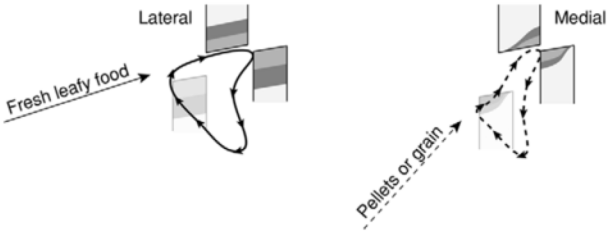

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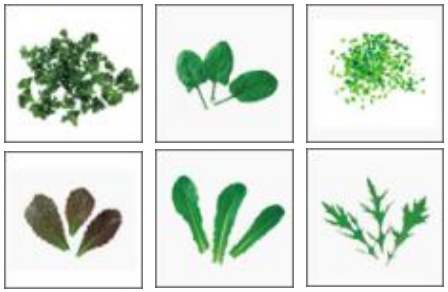
Eine Standardfütterung (hauptsächl. Heu/Gras, kein Müsli/Getreide, kein Obst/buntes Gemüse, mineralisiertes Ergänzungsfutter) und –haltung (Nagemöglichkeiten) sollten davor ausreichend schützen.



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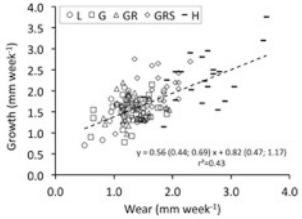
Eine besondere Abrasivität der Nahrung ist nicht notwendig.



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Eine besondere Abrasivität der Nahrung ist nicht notwendig.

Zuchthygiene vermutlich wichtiger als die Fütterung: gesunde Zähne passen sich an die Nahrung an.

vielen Dank für Ihre Aufmerksamkeit