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Short communication: Pre- and postmilking anatomical characteristics of teats and their associations with risk of clinical mastitis in dairy cows

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ABSTRACT

The primary objective of this study was to describe and compare anatomical characteristics of teats before and after machine milking adjusted for parity and teat location (front versus rear). The second objective was to determine if selected milking and anatomical characteristics of teats were associated with occurrence of clinical mastitis. To address objective 1, a cross-sectional study was done to describe and compare teat dimensions before and after milking (n = 1,751 teats from 445 cows). To fulfill objective 2, a case-control study was performed. Quarters having their first case of clinical mastitis in the current lactation from 2 mo before to 2 mo after the day the teats were measured were selected as cases (n = 47), provided no other quarters from that cow were affected by clinical mastitis at that time. Three controls (n = 141) were matched with each case; these were selected from quarters that did not experience any case of clinical mastitis during their current lactation. A conditional logistic regression model was used to determine associations between teat dimensions and occurrence of clinical mastitis. Primiparous and multiparous Holstein cows were enrolled in both studies. As compared with premilking dimensions, postmilking teats were longer and narrower at the barrel and the apex. Significant interactions between teat position and parity were identified for premilking teat length and diameter of the teat barrel. Premilking, teats were longer and wider with increasing parity. Front teats were longer and wider than rear teats premilking. Also during premilking, differences between the front and rear teat were less at increasing parity. Teat apex diameter was greater for premilking teats of cows in parity ≥3 and the apexes of front teats were wider than those of rear teats. Teats enrolled in the case-control study had twice as many clinical mastitis cases in front quarters compared with rear quarters. Premilking diameter of the teat apex was positively associated with risk of clinical mastitis (odds ratio = 1.20 per 1-mm increase in the diameter of the apex of the teat, 95% confidence interval = 1.05–1.37). Milking machine-related changes in teat dimensions had no association with occurrence of clinical mastitis.
Key words: dairy, clinical mastitis, milking machine, teat

Short Communication

Mastitis is defined as inflammation of the mammary gland, which in the vast majority of cases is caused by IMI (Hogan et al., 1999). Preservation of the teat canal and of the integrity of adjacent tissues is critical to resist infection and prevent mastitis (Seykora and McDaniel, 1985; Zucali et al., 2008). Milking machines can contribute to increased risk of mastitis by influencing health of the teat canal and teat skin (Mein, 2012). Anatomic characteristics of teats can be divided into 3 segments: (1) teat base, which connects the teat to the udder; (2) teat barrel, middle part between the base and the apex, and (3) teat apex, the most distal part of the teat and includes the teat canal (Figure 1A). The dimensions of the teat and milking-induced changes in teat dimensions may be associated with risk of IMI. According to Zwertvaegher et al. (2013), milk from quarters with wider teat barrels (postmilking) had greater quarter level SCC compared with milk from quarters with thinner teat barrels. The primary objective of the current study was to describe and compare anatomical characteristics of teats before and after machine milking adjusted for parity and teat location (front vs. rear). The second objective was to determine if milking and anatomical characteristics of teats were associated with occurrence of clinical mastitis. The first objective was addressed using a cross-sectional study, whereas the second objective was addressed with a case-control study.

The study population consisted of all 445 lactating Holstein cows of the University of Wisconsin Dairy

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Cattle Research Center, and both multiparous (n = 273) and primiparous (n = 172) cows were eligible for enrollment. All cows were milked in a double 16 parallel milking parlor. Premilking cow preparation consisted of teat disinfection using 0.5% iodine, removal and observation of foremilk, drying of the teats using cloth towels, followed by unit attachment. Automatic take-offs (cup removers) were set at a milk flow threshold of 0.6 kg/min. Following unit removal, teats were dipped in 1% iodine. The milking machine was set at a pulsation rate of 60 pulsations per min, and milking system vacuum level of 44.5 kPa with a 60% pulsation ratio. Round teat cup liners (WestfaliaSurge Classic Pro GQ silicone liners head 51; GEA Farm Technologies, 2010, Bönen, Germany) were used. Liners had a mouthpiece opening diameter of 23 mm, mid-barrel diameter (at 75 mm down) of 20 mm, mouthpiece chamber depth to upper collapse point of 40 mm, lower collapse point (below mouthpiece opening) of 118 mm, and a wall thickness of 2.5 mm.

Teats from all lactating cows were measured once between December 2013 and January 2014 either during the morning or the afternoon milking by one researcher before unit attachment (**PRE**) and immediately after removal of the milk unit (**POST**). Teat dimensions were measured using a translucent measuring ruler with a scale unit of 2 mm (instrumental uncertainty 1 mm), which illuminated the teats with a white light-emitting diode lamp (WestfaliaSurge Inc., Naperville, IL). All measurements were video recorded using a GoPro HERO 3 Black Edition camera (GoPro Inc., San Mateo, CA) to verify the information. Measurements were teat length from the base to the teat end, teat diameter at the barrel (middle part of the teat), and teat diameter at the apex (about 25% of the teat's total length from the teat end, this is approximately 10 to 15 mm above the teat end; Figure 1B). Milking-induced changes of each of the measured segments were calculated as POST minus PRE dimensions. Relative changes of each of the measured segments were calcu-

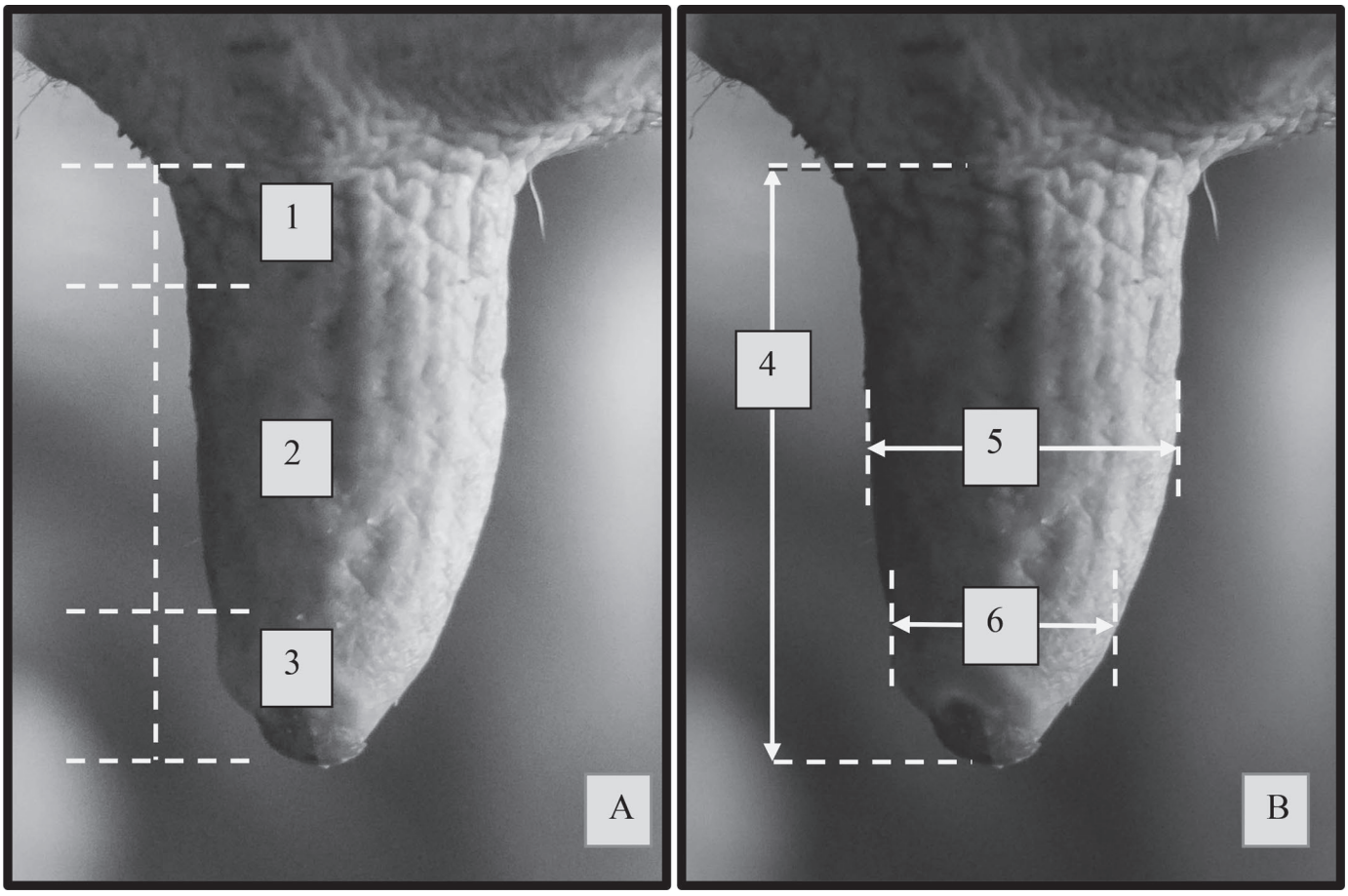

Figure 1. Anatomical portions of the teat and measured segments. (A) Anatomical division of the teats: (1) teat base, (2) teat barrel, and (3) teat apex. (B) Teat segment measured before unit attachment and immediately after automatic unit detachment: (4) teat length, (5) teat barrel diameter, and (6) teat apex diameter.