# Incidence of Meatal Stenosis following Neonatal Circumcision in a Primary Care Setting

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**Summary:** The objective of this study was to prospectively document the incidence of meatal stenosis in boys. The study included a consecutive sample of boys whose visit with the physician included a genital examination in a private primary care pediatric practice in rural northern Wisconsin. Meatal stenosis was diagnosed in boys from 1.94 to 12.34 years of age. The diagnosis was made in 24 of 329 circumcised boys who were Tanner I development and older than 3 years of age (7.29%, 95%CI=4.48-10.10%). Nearly all required meatotomy to resolve their symptoms. All of the boys with meatal stenosis were circumcised neonatally (exact OR=3.54, 95%CI=0.62-∞). The ratio of circumcised boys to noncircumcised boys in this study provided 80% power to demonstrate a 21.4% difference in the incidence of meatal stenosis between circumcised and noncircumcised Tanner I boys 3 years and older. Meatal stenosis may be the most common complication following neonatal circumcision. The frequency of this complication and the need for surgical correction need to be disclosed as part of the informed consent for neonatal circumcision. A careful meatal examination is indicted in any circumcised boy with abdominal or urinary complaints. *Clin Pediatr.* 2006;45:49-54

## Introduction

While a lot of attention has been focused on complications immediately following neonatal circumcision, many circumcised boys experience problems that manifest themselves well after the initial scars have healed. Meatal stenosis may be the most common complication following circumcision,[1-7] and has been recognized as such for decades.[8-13] In 1881, Mastin noted that narrowing of the meatus was so common in Jews that meatotomy was referred to as their "second circumcision."[14]

Despite general recognition as occurring almost exclusively in circumcised males, meatal stenosis as a sequela of circumcision merited minimal mention in the 2 most recent task force reports on neonatal circumcision issued by the American Academy of Pediatrics.[15,16] Consequently, many practitioners may be unaware or may underestimate the risk for meatal stenosis following neonatal circumcision. This study provides an estimate of the incidence of symptomatic meatal stenosis in boys cared for in a primary care pediatric practice.

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## Methods

The study population consisted of a consecutive sample of males up to 18 years of age who had their genitals examined by the author in Minocqua, Wisconsin, between June 1, 1995, and May 31, 2001. These examinations included sports physicals, well-child examinations, and sick visits where a genital examination was part of the physical examination for a specific problem. A boy was diagnosed with meatal stenosis if he had symptoms consistent with meatal stenosis, such as dysuria, voiding complaints, stream abnormalities, or abdominal discomfort, and a meatal opening 2 millimeters or smaller. Circumcision status was determined by physical examination. Data collected through April 30, 1997, have been reported previously.[17]

Associations between circumcision status, age, and Tanner stage and a diagnosis of meatal stenosis were evaluated by using chi-square tests, Fisher's Exact Test, logistic regression, and logistic regression with repeated measures (marginal mixed model). These analyses were performed using SAS version 8.2 (SAS Institute, Cary, NC). Exact logistic regression and Poisson regression was performed using LogXact version 5.0 (Cytel Software Corporation, Cambridge, MA). Time-to-event analysis using exact log-rank and Wilcoxon-Gehan tests was performed using StatXact version 5.0 (Cytel Software Corporation, Cambridge, MA). A power analysis was also performed.

Approval for the initial study[17] was obtained by the Marshfield Clinic Institutional Review Board. As this study examined information gathered as part of routine medical care, it was exempt from needing parental consent.

## Results

Data were collected on 1,100 subjects who received 2,068 genital examinations. Of these, 1,009 were circumcised. None of the noncircumcised boys were diagnosed with meatal stenosis. The incidences of meatal stenosis in circumcised boys at various stages of development are shown in Table 1. Patients with meatal stenosis ranged from 1.94 to 12.34 years of age at the time of diagnosis. The average age was 6.32 years (SD=3.05 years) with a median of 5.28 years. These boys were referred to a urologist, and nearly all underwent meatotomy. Comparisons of the incidence of meatal stenosis in noncircumcised and circumcised boys are shown in Table 2. None of the associations were statistically significant.

Controlling for the number of genital examinations performed on each patient had little impact on the effect of circumcision status (data not shown).

Exact Poisson regression using the natural logarithm of the age of the patient at the time of the last visit as the denominator (offset) failed to demonstrate statistically significant differences for the study population as a whole (RR=3.25, 95%CI=0.58-∞), for Tanner I boys (RR=3.95, 95% CI=0.69-∞), or for Tanner I boys 3 years and older (RR=3.09, 95%CI=0.55-∞).

Time-to-event analysis, using the age at diagnosis in those with meatal stenosis and the age at the time of last visit in the censored subjects, found no difference based on circumcision status when all subjects were considered (Exact Log Rank p=0.1568, Exact Wilcoxon-Gehan p=0.1547). When only Tanner I boys were considered and stratified by the number of genital examinations, the difference based on circumcision status approached statistical significance (Exact Log Rank p=0.0594, Exact Wilcoxon-Gehan p=0.0662).

With the total number of subjects in this analysis, this study had an 80% chance of detecting an 8.4% difference in the rate of meatal stenosis between circumcised and noncircumcised boys. If only Tanner I boys are considered there was 80% power to detect a 9.7% difference, while among Tanner I boys over 3 years of age there was 80% power to detect a 21.4% difference. This indicates that the number of noncircumcised boys in this study provided

**Table 1**

**INCIDENCE OF MEATAL STENOSIS IN CIRCUMCISED BOYS BY AGE GROUP**

| Age Group | Percentage | 95% Confidence Interval |
|---|---|---|
| All subjects | 2.78% | 1.76–3.79% |
| Tanner I | 3.49% | 2.20–4.79% |
| Tanner I over 3 years | 7.29% | 4.48–10.10% |

**Table 2**

**COMPARISON OF MEATAL STENOSIS IN NONCIRCUMCISED AND CIRCUMCISED BOYS BY AGE GROUP**

| Age Group | Meatal Stenosis | Normal | Exact Odds Ratio | 95% Confidence Interval |
|---|---|---|---|---|
| All patients: | | | | |
| Noncd | 0 | 91 | | p=0.1607 |
| Cd | 28 | 981 | 3.54 | 0.62-∞ |
| Tanner I: | | | | |
| Noncd | 0 | 77 | | p=0.1625 |
| Cd | 27 | 746 | 3.95 | 0.69-∞ |
| Tanner I over 3 years: | | | | |
| Noncd | 0 | 30 | | p=0.2433 |
| Cd | 24 | 305 | 3.31 | 0.56-∞ |

Noncd = noncircumcised, Cd = circumcised.

insufficient power to statistically demonstrate a clinically important difference in incidence of meatal stenosis.

## Discussion

Meatal stenosis occurred in 7.29% of Tanner I boys over 3 years of age and older who were circumcised at birth. This is consistent with the finding published on the data collected through April 30, 1997, in which 8% were diagnosed with meatal stenosis.[17] When compared to the rates of other complications following neonatal circumcision, meatal stenosis may be the most common complication for this procedure.

These findings are consistent with those published elsewhere in the medical literature. In one prospective study of 140 elective circumcisions, 4 (2.86%, 95%CI= 0.10-5.62%) developed meatal stenosis requiring formal meatotomy,[18] and in a second study of 117 circumcisions, 13 (11.11%, 95%CI=5.42-16.81%) developed meatal stenosis necessitating meatotomy.[19] In a population with a circumcision rate greater than 90%, Allen and Summers[20] screened 1,800 healthy boys between the ages of 6 and 10 years for meatal stenosis by using visual inspection. Significant meatal stenosis was found in 578, of whom at least a third had a "pinpoint meatus."[21] During a time period when 788 boys were born, 28 (3.55%, 95%CI=2.26-4.85%) boys with meatal stenosis sufficiently severe to require meatotomy were seen at the Royal Newcastle Hospital in Australia at a time when the incidence of neonatal circumcision was high.[22]

In a 3-year period Persad et al[23] performed 88 circumcisions and 91 preputial plasties for phimosis. Seven (7.95%, 95%CI= 2.30-13.61%) of the circumcision patients and none of the preputial plasty patients developed meatal stenosis (Fisher's Exact Test p = 0.0061).

The cardinal symptoms of meatal stenosis are penile pain at the initiation of micturition, narrow high-velocity stream, and the need to sit or stand back from the toilet bowl to urinate.[23] Frequency of symptoms is summarized in Table 3.

On general inspection the lengths of the meatus should be 25 to 30% of the diameter of the glans.[2] Normal male children have, with some variation, a physiological eversion of the distal urethral mucosa through the urethral meatus (also known as the meatal

**Table 3**

**PRESENTING SYMPTOMS OF BOYS WITH MEATAL STENOSIS IN PREVIOUSLY PUBLISHED STUDIES**

| Symptom | Persad[23] | Noe[38] | Upadhyay[41] |
|---|---|---|---|
| Number of boys | 12 | 280 | 34 |
| Dysuria | 12 (100%) | 36 (13%) | 11 (30%) |
| Stream changes | 8 (67%) | 13 (36%) | |
| Hematuria | 1 (8%) | 27 (10%) | |
| Enuresis | | 65 (23%) | 7 (19%) |
| Sit to micturate | 6 (50%) | | |
| Found on routine PE | | 66 (24%) | |
| Urgency/frequency | | 38 (14%) | |
| History of UTI | | 48 (17%) | |
| Straining | | | 5 (14%) |
| Urinary retention | | | 3 (8%) |
| Dribbling | | | 2 (6%) |

PE = physical examination, UTI = urinary tract infection.

"lips").[23] In circumcised males, eversion of these lips is difficult to demonstrate, and the formation of a ventral lip of tissue with concomitant secondary meatal narrowing causes deflection of the urinary stream upward.[4]

Irritation leading to inflammation was posited as a cause for "permanent contraction" of the meatus in 1885.[24] Irritation can be in the form of the meatus rubbing aginst clothing, or exposure to urine and feces in the diaper. This theory for development of meatal stenosis in circumcised boys has subsequently been posited by others[23,25,26] and expanded to placing the blame on the polyacrylate in superabsorbent diapers.[27]

Postcircumcision meatal stenosis may also result from ischemia of the meatal mucosa secondary to damage to the frenular artery. While the area of vascularization supplied by the frenular artery has not been clearly described, the frenulum could be considered the 'mesoartery' that links the vascularization of the penile shaft to the penile core. This may explain why postcircumcision meatal stenosis universally involves the ventral meatus.

Graves[28] speculated, citing no statistics to support his clinical observations, that meatal stenonsis is more commom following a Plastibell circumcison than following a Gomco circumcision. He believed that the freehand and traditional methods resulted in a normal meatus.[28] Others have failed to confirm his impressions,[29] and no systematic study of the relation between circumcision technique and the risk for meatal stenosis has been undertaken.

Meatal stenosis is essentially unheard of in the intact male,[30] except as a complication of balanitis xerotica obliterans,[31-35] venereal disease,[34] or traumatic catheterization.[6]

Questions regarding the potential long-term effects of a narrowed meatus remain unanswered.[4] Meatal stenosis can lead to such serious urinary tract problems as infection, decompensation of the bladder, vesicoureteric reflux, hydronephrosis, and kidney failure.[36-40] In one study vesicoureteric reflux resolved in 7 of 13 patients following meatotomy,[39] and a report of 2 cases noted resolution of reflux and hydronephrosis following meatotomy.[40]

Meatal stenosis is a common problem that occurs almost exclu-

sively in circumcised boys. The frequency of this complication is reflected in the publication of large series of cases following infant circumcision,[27,38,41] and the need for an American Academy of Pediatrics policy statement in 1978.[4] Similarly, in several case series from India and France, circumcised males are overrepresented among those with meatal stenosis.[6,23,32]

In the 1950s, Berry and Cross[42] demonstrated that circumcised men have smaller meatal openings than noncircumcised men (mean diameter (French)±SD, 22.7±3.6 versus 19.9±4.3, p<0.0001) and more likely to have meatal openings 18 French or smaller (Exact OR=6.01, 95%CI=2.79-13.98) or 16 French or smaller (Exact OR=4.30, 95%CI=1.78-11.57). Likewise, in children, intact boys had larger meatal openings (13.3±1.6 versus 12.6±1.6, p=0.0077), while circumcised boys were more likely to have a meatal opening 12 French or smaller (OR=2.44, 95%CI=1.36-4.41). Among circumcised adults, the age at which circumcision occurred (neonatal versus later) did not affect meatal size (p=0.3164).[42] In contrast, a French study found no statistically significant differences in meatal calibre between noncircumcised men, those circumcised as newborns, and those circumcised later in life.[43]

In 1935, Van der Bogert recognized the connection between circumcision and the complications of meatitis and meatal stenosis.[11] In the same year, Thompson[10] reported on 70 cases of narrowed meatus, 4 of these cases in circumcised males, all just under 19 years of age. In 1938 Abeshous and Bogorad[12] reported 13 cases of meatal coarctation, of whom 12 were circumcised. Freud[13] reported 25 cases of meatal ulceration in 1947. Of the boys, 21 were circumcised; 7, 6 of whom were circumcised, required meatotomy.[13]

Circumcision proponents have dismissed the meatal stenosis seen in circumcised boys as either nonexistent or of no clinical importance.[44-48] Despite the clear documentation of the consistently strong association between circumcision and meatal stenosis, the 1989 statement of the American Academy of Pediatrics Task Force on Circumcision made only one unreferenced allusion to meatal stenosis: "there is no evidence that meatitis leads to stenosis of the urethral meatus."[15] Subsequently, the 1999 Task Force report mentioned meatal stenosis in the context of being reported in "isolated case reports."[16] It is unclear whether this represents a bias on the part of the members of the Task Force or a failure to adequately review the medical literature.

Although this was a prospective analysis, a genital examination was performed only if indicated, usually at a well-child visit or for a complaint for which a genital examination would be warranted. This bias may have slightly increased the estimated incidence of meatal stenosis, but the impact of this potential source of bias is tempered by the predominance of examinations associated with well-child visits. The population studied was highly circumcised, consequently the number of noncircumcised boys limited the ability to statistically demonstrate the contrast in the incidence of meatal stenosis based on circumcision status.

Meatal stenosis is a common sequela to circumcision whether performed on the neonate or later in life. With an incidence greater than that reported for infection or bleeding, the risk of meatal stenosis following circumcision needs to be disclosed whenever informed consent is obtained for this procedure. National medical organizations need to address the consequences of this long-recognized complication of this common procedure. When surgery on the prepuce is unavoidable, preservation of the frenular artery or the use of less drastic prepuce-sparing procedures is advised to avoid the subsequent risk of meatal stenosis.

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