

Overview of elastin levels in the prepuce of children with and without phimosis

Hanif Fauzie,^{1*} Erjan Fikri,² Ichwan²

¹Resident of Surgery Department, Faculty of Medicine, University of North Sumatera, Medan, Indonesia

²Staff of Surgery Department, Faculty of Medicine, University of North Sumatera, Medan,

Abstract

Introduction: The prepuce is a specialized and innervated mucocutaneous tissue that covers and protects the glans. Phimosis is the inability to retract the prepuce or the prepuce of the penis narrowing behind the glans penis. Elastin is the main component of elastic fibers, which provide stretch, recoil, and elasticity to the skin. The purpose of this study was to determine the description of elastin levels in the prepuce of children with and without phimosis.

Methods: This study design is an unpaired analytical observational study with a case-control design method, to analyze the description of elastin levels in the prepuce of children with and without phimosis.

Results: In this study, the mean age in the phimosis group was 7.55 ± 2.3 years. In the normality test using Saphiro Wilk (sample 0.05) while in the non-phimosis group it was not normally distributed ($p < 0.05$). The mean sore throat of group A was 1.81 ± 0.68 and group B was 2.05 ± 0.74 with p value 0.284 ($p > 0.05$). In the phimosis group, the mean elastin expression was 4.32 ± 1.46 and in the control group, the mean elastin expression was 8.75 ± 1.66 . From these results, there is a difference in the amount of elastin expression in the two groups ($p < 0.05$).

Conclusion: there is a difference in the amount of elastin expression, where it is found that in the phimosis group the amount of elastin expression is lower than the control group.

Keywords: Elastin, Phimosis, Prepuce

Introduction

The prepuce is a specialized and innervated mucocutaneous tissue that covers and protects the glands. After the age of 3 years, keratin cysts form beneath the adhesion of the prepuce and, in conjunction with intermittent erections, can enlarge the phimotic ring, exposing the glands. Approximately 80 to 90% of uncircumcised boys are able to retract the foreskin to expose the glands after the age of 3 years. Pathological phimosis is characterized by a fibrotic ring of the prepuce that does not allow for gland exposure.¹

Phimosis is the inability to retract the foreskin or narrow foreskin of the penis. Phimosis is an uncommon complaint for which a child is brought to the hospital. Parents are often very anxious and concerned about their infant or toddler who cannot be retracted. Most of these cases end with surgical intervention, such as circumcision.² In general, phimosis is classified into two types: physiological phimosis and pathological phimosis. The majority of phimosis that occurs in male infants is physiological phimosis, typically occurring at the age of 2 to 3 years. In 80-90% of uncircumcised children, the preputial skin can be retracted over the glans penis by the age of 3 years. Boys who experience recurrent balanitis or balanoposthitis are at risk of developing scar tissue at the preputial opening, which also contributes to pathological phimosis.³

Elastin is a key component of elastic fibers, providing stretch, recoil, and elasticity to the skin. Normal levels of elastin fiber production, organization, and integration with other extracellular matrix proteins in the skin, such as proteoglycans and glycosaminoglycans, are integral in maintaining the health, function, and youthful appearance of the skin. With aging and environmental exposure, elastin fibers decline. This degradation contributes to the loss of structural integrity in the skin; coupled with the loss of subcutaneous fat, it results in looser and sagging skin, leading to unwanted changes in appearance. On the other hand, collagen is a fundamental component for forming most tissues and organs, playing a crucial role in cell growth and differentiation processes, generated from the specific structure of collagen fibers and their ability to adhere. Advances in research techniques allow for a detailed study of the molecular structure and properties of collagen.^{4, 5}

Methods

This study is an unmatched analytical observational research using a case-control design. In this study, groups with and without phimosis were identified to analyze the levels of elastin in the prepuce of children with and without phimosis at Adam Malik Hospital in Medan. The study involved a total of 18 samples in each group. Inclusion criteria for this study were as follows: willing to participate in the study by signing the informed consent, patients aged over 3 years with phimosis, and patients aged over 3 years without phimosis who have not been circumcised. Parents/guardians provided consent to participate in this study and signed the informed consent. The exclusion criterion was children with other genital abnormalities.

Results

This study was an unmatched analytical observational research using a non-matched case-control design, analyzing the levels of elastin in the prepuce of children with and without phimosis in Medan. The study involved 40 children with and without phimosis who underwent circumcision from July 2023 to September 2023 at various locations in the city of Medan. The mean age of children in the phimosis group in this study was 7.55 ± 2.3 years, with the highest age being 11 years and the lowest being 3 years. Meanwhile, the mean age of children in the control group was 8.3 ± 2.15 years, with the highest age being 11 years and the lowest being 4 years. The basic characteristics data of all subjects are presented in Table 1.

Table 1. Distribution of Mean Age and Elastin Levels with respect to Phimosis

Variable	Control	Phimosis	P Value
Total Sample	20	20	
Age (years)	8.30 ± 2.155	7.55 ± 2.305	0.294
Elastin Area (%)	8.75 ± 1.669	4.32 ± 1.46	< 0.0001

Regarding the examination results of elastin expression, in this study, staining was performed using Verhoeff-van Gieson to assess the elastin levels in the dermal layers. Digital analysis method was observed on prepuce specimens at a magnification of 400 times, and each preparation was photographed three times using an Olympus camera. Subsequently, elastin expression photos that were homogeneous with the most intense brown color were selected. The counting of elastin expressions in the prepuce was carried out using Adobe Photoshop CS3 and Image J software.

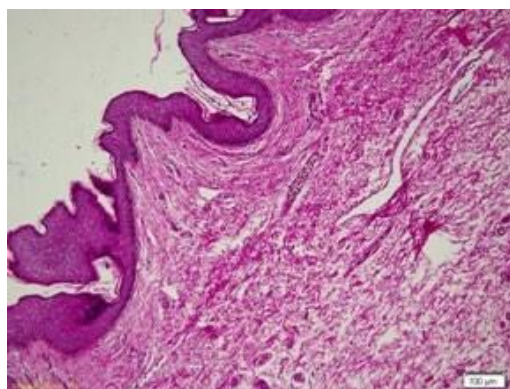


Figure 4.1 Histological Image of Prepuce with Verhoeff-van Gieson Staining at 100x Magnification

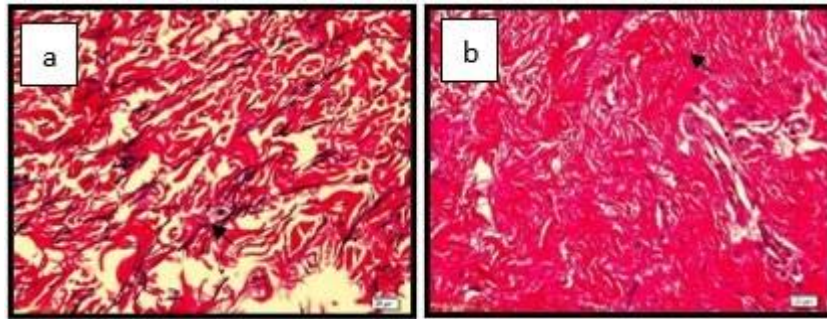


Figure 2. a) Elastin fibers in the prepuce of the control group (Verhoeff-van Gieson staining), where elastic fibers appear black. b) Histological image of the phimosis group, showing fewer elastic fibers. (Figure 2b) Elastin fibers are significantly fewer compared to the control group.

The results of the normality test using Shapiro-Wilk (for samples <50) indicate that the data distribution for age and percentage area in the phimosis group is normally distributed ($p>0.05$), whereas in the non-phimosis group, it is not normally distributed ($p<0.05$). Hence, a non-parametric test, specifically the Mann-Whitney U test, will be used to analyze the differences. The Mann-Whitney U test results show no significant difference in age between the two groups ($p>0.05$). In the phimosis group, the mean elastin expression was found to be 4.32 ± 1.46 , while in the control group, the mean elastin expression was 8.75 ± 1.66 . There was a difference in the number of elastin expressions between the two groups, with the phimosis group having a lower number of elastin expressions compared to the control group. The conclusion drawn is that there is a statistically significant difference in the percentage area between the two groups ($p<0.05$).

Discussion

Physiological phimosis affects 96% of newborns, and its incidence decreases with age. At the age of 3 years, 10% of patients experience pathological phimosis, decreasing to only 1% at the age of 14 years. In this study, the subjects included 40 children ranging from 3 to 11 years old, divided into two groups. There was no statistically significant difference in age found in this study ($p>0.05$). The preputial skin is a pentalaminar structure consisting of squamous mucosal epithelium, lamina propria (chorion), dartos muscle, dermis, and outer skin. The difference in elastic fibers in the lamina propria and dermis also contributes to the formation of a 'muzzle' configuration around the glans penis. Elastic tissue in the dermis of the preputial skin, along with the dartos muscle and frenulum, binds the preputial skin and helps return it to its anatomical position after an erection or manual retraction.³

In the variable of elastin expression percentage, the control group showed a value of 8.75 ± 1.669 , and the phimosis group had a value of 4.32 ± 1.46 , with a p-value of 0.0001. The results of this study indicate a significant difference in the percentage area of elastin between the control and phimosis groups. The abnormality in elastic fibers in phimosis is explained by previous research by Rosado et al, which stated that elastic fibers in the skin of smokers are fewer, narrower, and more fragmented compared to

the prepuce of the control group. The observed changes in elastic fibers are similar to those observed after sun-induced damage, affecting the entire dermis, except that the papillary dermis in the phimosis population remains unaffected. The difference in the occurrence of phimosis with the percentage area of elastin in the samples in this study yielded a p-value of 0.001 ($p < 0.05$), indicating a significant difference between the occurrence of phimosis and the percentage area of elastin.

A study by Favorito et al. compared elastin fiber levels in the prepuce of phimosis patients undergoing topical treatment with betamethasone and hyaluronidase. The study found that the group that did not respond well to the topical treatment had lower levels of elastin compared to the group that responded successfully. Although the statistical data did not show a significant difference between the two groups ($p = 0.056$), the reduction in elastic fibers in the preputial skin of patients undergoing topical treatment with the cream was noted. This reduction, although not significant, is a characteristic of the healing process associated with this treatment. The increase in elastin fiber concentration is associated with greater tissue expansion. For easier exposure of the glands, the preputial skin requires a higher concentration of elastin fibers. The reduction in elastin fibers in the preputial skin of phimosis patients undergoing treatment with betamethasone + hyaluronidase is similar to what occurs in the healing process and can be linked to the greater difficulty in exposing the glans; these patients did not report infections in the preputial skin.⁶

Conclusion

There is a significant difference between the occurrence of phimosis and the percentage area of elastin in the samples, with the elastin area percentage being lower in the non-phimosis group.

Conflict of Interest

There is no conflict of interest in this study.

References

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