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TOPIC PAPER

Buccal mucosa graft for simultaneous correction of severe chordee and urethroplasty as a one-stage repair of scrotal hypospadias (watch technique)

Miroslav L. Djordjevic[1,2] · Marta Bizic[1,2] · Borko Stojanovic[2] · Marko Bencic[2] · Vladimir Kojovic[1] · Gradimir Korac[2]

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Abstract

Purpose Severe hypospadias repair still presents a great challenge. We evaluated a novel approach of using a specially shaped buccal mucosa graft for simultaneous ventral tunica grafting and new urethral plate creation, in combination with longitudinal dorsal island skin flap, as a one-stage repair of severe hypospadias.

Methods Between July 2014 and September 2017, 26 patients (aged from 12 to 22 months) underwent scrotal hypospadias repair. Short and non-elastic urethral plate is divided. Buccal mucosa graft is harvested from the inner cheek, and designed in a special "watch" shape, with the spherical part in the middle and two rectangular parts on both sides. Tunica albuginea is opened ventrally for penile straightening and grafted to the spherical part of the "watch-shaped" buccal mucosa with 6–8 "U-shape" stitches. The rectangular parts are fixed to the tip of the glans distally and native urethral meatus proximally. Longitudinal dorsal skin flap is harvested, button-holed ventrally and joined with buccal graft. Penile skin reconstruction is performed using available penile skin.

Results The mean follow-up was 22 months (range from 9 to 46 months). Satisfactory results were achieved in 22 patients. Two urethral fistulas were successfully repaired by minor surgery after 3 months, while one meatal stenosis and one urethral diverticulum were successfully treated by temporary urethral dilation. There were no cases of residual curvature.

Conclusion Specially shaped buccal mucosa graft for simultaneous curvature correction and urethroplasty could be a good choice for single-stage repair of scrotal hypospadias with severe curvature.

Keywords Penis · Scrotal hypospadias · Penile curvature · Buccal mucosa graft · Watch-shaped graft · Urethroplasty

Introduction

Hypospadias presents one of the most common congenital malformations of male genitalia and its correction presents a great challenge for pediatric urologists. Despite the fact that tubularized incised plate urethroplasty described by Snodgrass still presents the gold standard in the treatment of distal hypospadias, the optimal treatment of proximal forms remains controversial [1–3]. Proximal hypospadias, penoscrotal and scrotal, are usually associated with marked ventral curvature and short urethral plate. The main dilemma is the choice between one-stage and two-stage techniques. Two-stage repairs are based on the initial correction of ventral curvature with creation of new urethral plate using preputial/penile skin flap or buccal mucosa graft and followed by urethroplasty in the second stage [4, 5]. Despite the lack of available penile tissue for urethral reconstruction in one stage, great experience with buccal mucosa graft in urethral stricture repair sparked the idea to combine it with preputial or/and penile skin for creation of the new urethra. We presented our initial results with the combination of dorsal longitudinal island skin flap and buccal mucosa graft as a one-stage repair of severe hypospadias [6]. In this approach, severe ventral curvature was corrected by dorsal plication of the tunica albuginea. However, possible risk of injuring the neurovascular bundle and additional shortening of the hypospadiac penis led us to search for new and better solutions. Based on experience in the treatment of

✉ Miroslav L. Djordjevic
djordjevic@uromiros.com

[1] School of Medicine, University of Belgrade, Belgrade, Serbia

[2] Department of Urology, University Children's Hospital, Tirsova 10, Belgrade 11000, Serbia

Peyronie's disease, we started to correct severe curvature by ventral tunica albuginea incision and grafting [7, 8]. Special, "watch"-shaped buccal mucosa graft is used for simultaneous ventral tunica grafting and new urethral plate creation. Thus, we evaluated our patients who underwent this novel approach as one-stage repair of scrotal hypospadias.

Methods

We retrospectively reviewed 26 boys (aged from 12 to 22 months), who underwent scrotal hypospadias repair from July 2014 to September 2017. All cases presented with a small penis with severe ventral curvature (more than 70°). There was no case with penile length less than 2.5 standard deviations below the mean for age (micropenis). In 16 cases, penoscrotal transposition was registered as well. In all cases, dihydrotestosterone was applied as a topical gel locally, twice a day for 3 weeks preoperatively, for penile enhancement (Fig. 1a). Two patients with associated vesicoureteral reflux were treated endoscopically prior to surgery.

Operative technique

A skin incision is made around the hypospadiac meatus and continued towards the coronal level. The penis is degloved preserving the whole urethral plate. Degloving is performed carefully to prevent injury of divergent spongiosal tissue and possible excessive bleeding. Short and non-elastic urethral plate is divided, and fibrotic tissue is removed to lengthen and straighten the penis (Fig. 1b). Artificial or pharmacological prostaglandin E1 erection is used for precise correction of the curvature and for checking it before, during and after repair. Tunica albuginea is incised and opened transversally at the point of maximal curvature. Incisions are made carefully and limited to the tunica, preserving the underlying cavernosal tissue. Laterally, the incision is continued in an H-shape to correct narrowing deformity and to create a circular ventral defect. A vascular clamp or tourniquet is placed under the defect to avoid bleeding from entering corpora cavernosa (Fig. 1c).

A buccal mucosa graft of a particular shape is harvested from the inner cheek. The graft is designed in a "watch" shape, with the spherical part in the middle and two rectangular parts extending to opposite sides from the spherical centre. Distance of the middle part depends on the position of tunical defect. Harvesting is done as a previously described [9]. Submucosal region is initially infiltrated with a solution of 0.25% bupivacaine in 1:200,000 epinephrine to minimize the bleeding of the donor site. In addition, the external orifice of the parotid gland must be kept apart during harvesting. The length of the graft depends on the distance between the tip of the glans and the urethral opening, while the width was usually 10 mm and 12–14 mm in the rectangular and spherical part, respectively. The donor site is carefully examined for bleeding and then closed with a running suture. After meticulous defatting, the graft is properly prepared and consists of mucosal and lamina propria layers. Middle part of the graft is anastomosed to the tunica albuginea edges using 6–8 U-shaped interrupted sutures of 5-0 poliglecaprone 25 (Monocryl, Ethicon, Johnson–Johnson), closing the tunical defect completely (Fig. 1d). Vascular clamp is removed, and erection is repeated to confirm a good correction of the curvature. Rectangular parts of the graft are then fixed, starting from the native urethral meatus to the tips of corporal bodies. Quilting is done to prevent graft movement and elevation. This creates a half of the urethra that covers corporal bodies.

Three flaps are created from the dorsal penile skin—middle longitudinal island flap for urethral and two lateral sliding flaps for penile skin reconstruction (Fig. 2a). Well-vascularized longitudinal island skin flap is button-holed ventrally and sutured to the edges of the buccal mucosa by one-layer running suture to form the neourethra over a 6 Fr silicone tube preventing tension to the suture lines. This tube is left in place as a urethral stent and used for postoperative wetting of the buccal graft. Abundant pedicle of the flap is fixed laterally to cover all suture lines of the neourethra, preventing fistula formation. Glans wings are used to cover the distal part of neourethra and to create a conically shaped glans (Fig. 2b–d). Penile shaft is reconstructed using two lateral skin flaps. In case of associated penoscrotal transposition, scrotoplasty is performed at the same stage, giving the anatomical relationship between the penis and the scrotum (Fig. 3a).

Coban® dressing is applied around the penis in a stretched position. Suprapubic catheter is left for 2 weeks. Wetting of the graft with saline solution through the urethral stent is mandatory every 3 h for the first 2 days, to improve mucosa survival. Urethral stent is removed 10 days after surgery. Oral antibiotics and oxybutinine are used to prevent postoperative infection and bladder irritation. Postoperative vacuum device is recommended for 3 months, preventing shrinkage of the buccal mucosa graft and recurvation.

Results

A total of 26 patients who underwent the novel "watch" technique were retrospectively analyzed. Follow-up ranged from 9 to 46 months (mean 22 months). Good aesthetic result with the meatus at the top of the glans and without penile deformities was achieved in all patients (Fig. 3b). The neourethra was checked by adequate calibration at 1, 2, 3, 6, and 12 months postoperatively. Further follow-up included regular clinical visits and calibration of urethra

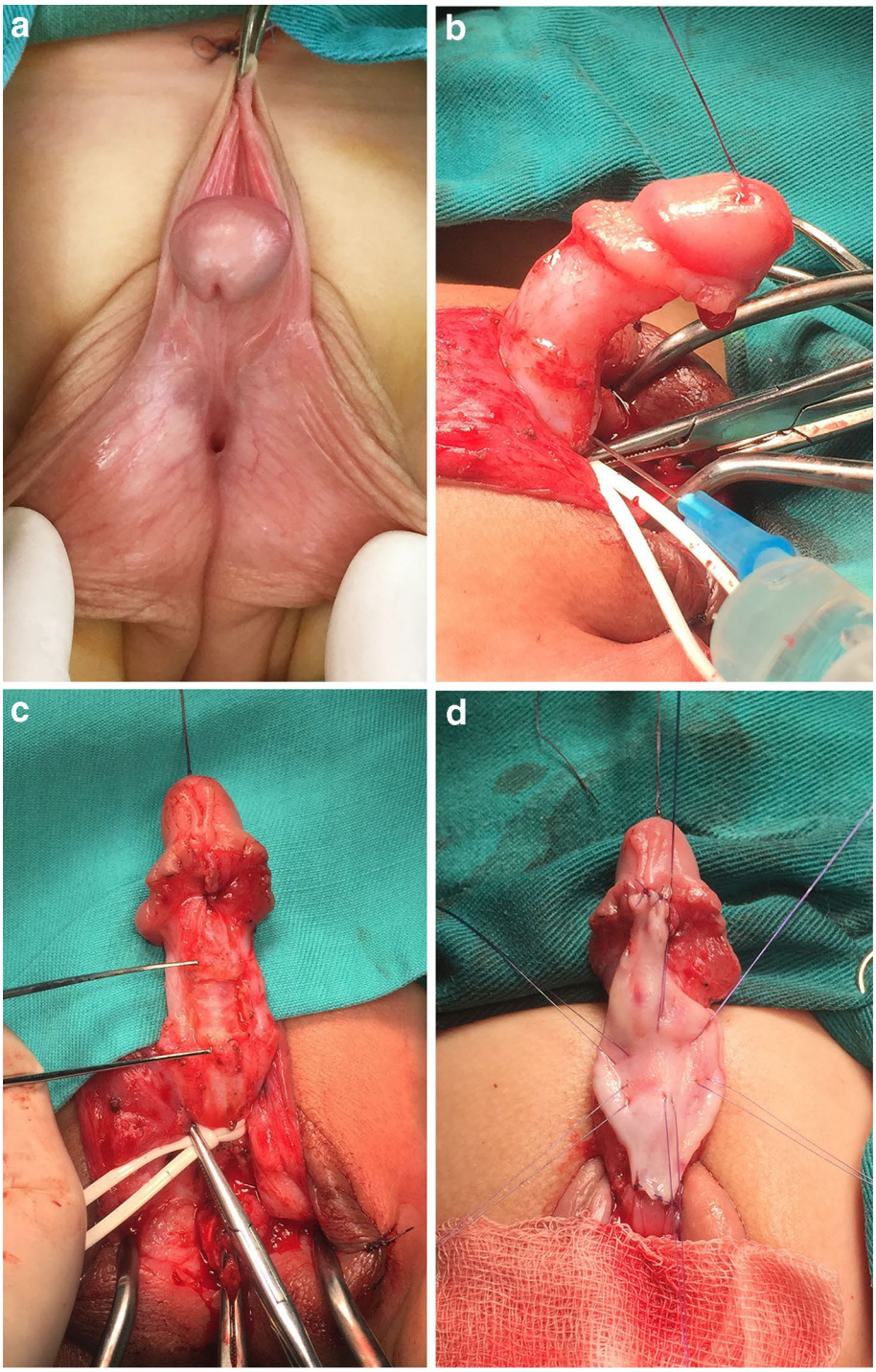

Fig. 1 **a** Scrotal hypospadias with severe ventral curvature, short urethral plate, and penoscrotal transposition. **b** Severe penile curvature exists after division of short and fibrotic urethral plate. **c** Penis is completely lengthened and straightened by tunica albuginea incision at the point of maximal curvature, leaving circular ventral defect. **d** Spherical part of "watch"-shaped buccal mucosa graft is fixed to the tunica albuginea edges with six U-shaped interrupted sutures. Rectangular parts of the graft are fixed proximally and distally. This way, new urethral plate is created

every 6 months. In 11 boys older then 4 years, the standard flowmetry was done with satisfactory results. Good caliber of urethra without complications like fistula or stenosis is achieved in 22 patients. One meatal stenosis and one urethral diverticulum were noted and successfully treated by temporary urethral dilation during a 6-week period. Urethral fistula occurred in two cases and was repaired 3 months later. There were no postoperative complications related to buccal mucosa donor site. In three cases, partial superficial dehiscence of the ventral penile skin occurred and was treated conservatively. Good result in curvature correction was obtained in all cases. However, this outcome assessment was subjective, since it was based on vacuum device checking and parents' reports.

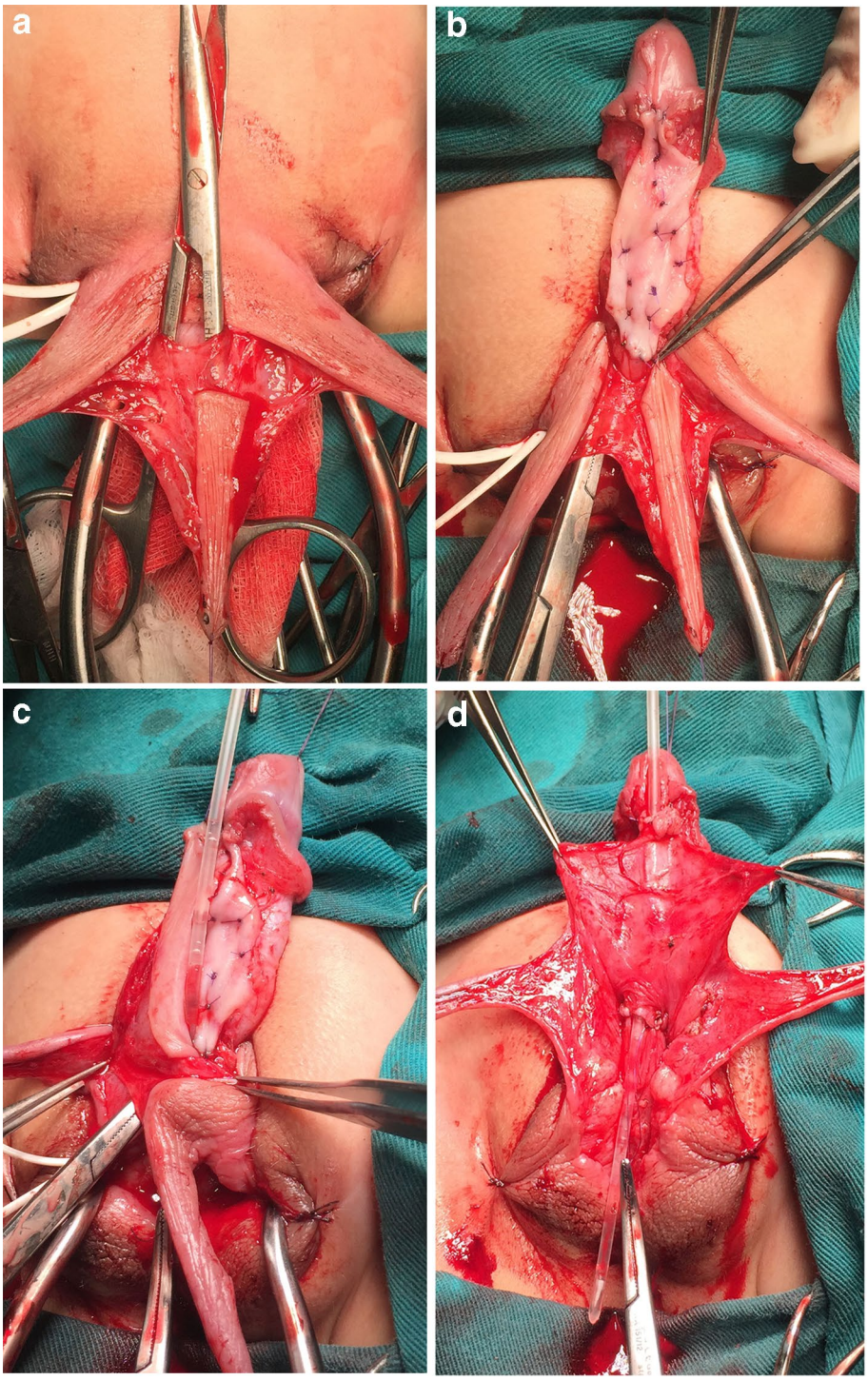

Fig. 2 **a** Longitudinal island skin flap is designed, and a button hole is formed at the base of the flap. **b** Buccal mucosa graft is quilted to the tunica albuginea, from hypospadiac meatus to the tip of the glans. Dorsal island skin flap is transposed ventrally. Two lateral skin flaps will be used for penile shaft reconstruction. **c** Island skin flap is joined with buccal mucosa graft to create the neourethra. **d** All suture lines are covered with the well vascularized pedicle

Discussion

Management of hypospadias presents a great challenge in the search of new and better solutions. Recently, Snodgrass procedure became a method of choice with a high success rate but only for distal hypospadias [10]. Various techniques have been described for proximal hypospadias and are usually based on urethral plate tubularization, onlay flaps, staged flaps, or grafts [11]. The main factors in the final selection between the available techniques are quality of urethral plate and associated chordee. Proximal hypospadias are usually associated with severe ventral curvature and short, usually undeveloped urethral plate. Urethral reconstruction also requires an extragenital tissue source due to a lack of material in severe hypospadias. Buccal or bladder mucosa, full and split thickness skin grafts from non-hair-bearing

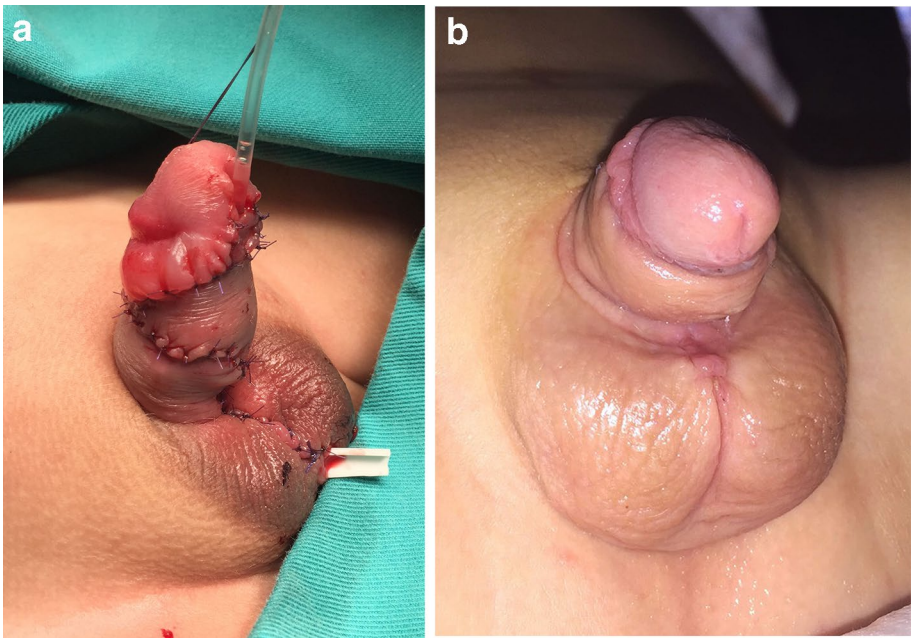

Fig. 3 **a** Appearance at the end of surgery. Penile skin reconstruction is done using two skin flaps. **b** Outcome 4 months after surgery. Penis has a good appearance

areas, are most commonly used tissues for urethral replacement [12, 13].

Several techniques exist for straightening of the penis in case of severe ventral curvature. One of the most commonly used includes dissection of the short and dysplastic urethral plate followed by dorsal tunical plication. However, it can shorten the already affected length in severe hypospadias. Lengthening procedures are based on dissection and division of the short urethral plate, tunica albuginea opening and grafting with different materials [14, 15]. The inability to continue with urethral reconstruction in the same stage is a limiting factor of this procedure.

Application of a free buccal mucosa graft for urethral reconstruction is becoming increasingly popular in certain clinical settings. They are tough, resilient, easy to harvest and easy to handle, and leave no visible donor site scar. The graft's histological composition gives it good potential for graft material [16]. We previously reported our experience in combined buccal mucosa graft and longitudinal dorsal onlay flap in the treatment of proximal hypospadias [6]. It was based on our familiarity with buccal mucosa graft in adult urethral reconstruction, with a goal to create a new urethra with a minimal complication rate. Buccal mucosa graft is hairless material, technically easy to use, with good elasticity and satisfactory survival chances [17]. However, correction of severe curvature by dorsal plication led to some shortening of the penis. While searching for a better solution, we came to the idea to reshape the buccal mucosa graft so as to allow it to be used for simultaneous ventral tunical grafting and new urethral plate creation. Our goal was to straighten and lengthen the hypospadiac penis as well as to create urethra in one stage repair. To avoid complications described after tubularized urethroplasty, we used combined buccal mucosa as the dorsal half of neourethra and the longitudinal island skin flap for its ventral part. One might ask why these cases did not undergo repair using a two-stage buccal mucosa graft instead of a combination of buccal graft and genital skin flap. If the length and width of the defect, after division of short and undeveloped urethral plate, exceed the size that can be bridged and tubularized with buccal mucosa grafts, it seems more logical to use a smaller graft and skin flap, since vascularized flap always gives better chance for successful outcome. In addition, using of smaller buccal mucosa graft is minimally invasive without consequences.

In the present report, we created a special "watch"-shaped graft with a spherical part in the middle and two rectangular parts on either side. The wider part of buccal mucosa is created to be sufficient to cover the defect of the tunica albuginea after its incision and opening. To our knowledge, the use of buccal mucosa as a graft for correction of penile deformities in children has not been reported, although some authors have used it in correction of Peyronie's disease [18, 19]. Once tunica albuginea is grafted, a transfer of the penile skin flap is needed for neourethral reconstruction. Our experience with longitudinal island skin flap has been previously reported in detail [20]. This flap is abundant, well vascularized and follows the axial course of blood vessels in the best possible way. The axial course of the blood vessels enables the creation of a very wide hole for the transposition of the flap using the button-hole maneuver, preventing postoperative penile rotation. The flap can be narrower, since there is no need for its tubularization. Two remaining lateral skin flaps are usually enough for penile skin reconstruction. The

abundant subcutaneous tissue of the flap covers all suture lines, thus preventing fistula formation.

Experience with our novel technique is limited, with short follow-up. Despite the fact that we can evaluate outcomes after urethroplasty, real straightening is reported by parents in majority of patients and the final outcomes will become visible in puberty. Therefore, we believe that straight erection reported by parents 1 year after surgery is promising, and will maintain into adolescence and adulthood. Last but not least, achieved esthetical outcomes with good positioned meatus and without penile deformities in early postoperative period are not enough and longer follow-up is needed for the final approval of presented technique.

Conclusion

Repair of scrotal hypospadias associated with severe ventral curvature is usually done as a two-stage procedure. Ventral incision and grafting of tunica albuginea presents the optimal solution for penile straightening and lengthening. Combined penile skin flap and buccal mucosa graft is a viable and reliable option for urethral reconstruction in one-stage repair. Our results suggest that a buccal mucosa graft appropriately shaped for a simultaneous curvature correction and urethroplasty seems to achieve the main goals for the most severe cases of hypospadias. Careful case selection and longer follow-up are paramount in achieving successful outcomes.

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Author contributions DML: project development, data collection, and manuscript writing. BM: data collection and analysis. SB: data collection and manuscript editing. BM: data analysis. KV: manuscript editing. KG: project development.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of human rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Formal consent For this type of study, formal consent is not required.

Informed consent Informed consent was obtained from all individual participants (parents or legal guardians) included in the study.

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