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# Henna (Mehndi) as radio-opaque marker for pediatric orthopaedic operations

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**Abstract**
**Introduction:** Accurate location of the physis is important in many pediatric orthopaedic operative procedures. Pre-operatively the physis can be identified by a simple plain radiograph, while intra-operatively a C-arm Image Intensifier serves as an essential equipment for localizing the physis. The physis is visible as a radiolucent area sandwiched between the epiphysis and the metaphysis. However, due to the unavailability of C-arm, per-operative accurate localization of the physis was a challenge. The purpose of this case series was to assess the usage of Henna (Mehndi) as a radio-opaque marker for pediatric orthopaedic operations for localization of the physis.
**Methods:** A preoperative true-size marker film was taken after drying of applied henna paste. Henna is radio-opaque and also stains the skin, the marks of which persist for several days. The marks of henna on the skin were intra-operatively used to correlate with the markings on the radiographic film for accurate localization of the physis in a series of cases of surgical correction of the uniplanar deformity around the knee at a tertiary level pediatric institute between October 2017 and December 2018.
**Results:** There were eleven cases in the study. Mean age at presentation was 9 years (range 7 to 12 years). Three cases had unilateral affection, while eight cases had bilateral affection. The average follow-up period was 30 months. All cases had their deformity corrected till the last follow-up.
**Conclusion:** Varieties of intra-operative skin markers have been used for the past several years, details of which are available in the literature. Henna is a near-ideal pre-operative skin marker as it is easily available, inexpensive, visible even after vigorous surgical skin preparation and normally has no untoward side effects. Our use of henna in pediatric orthopaedic surgeries for localizing the physis has not been reported in the literature as of date.

**Keywords:** Henna, mehndi, marker film, physis, pediatric orthopaedic operations

## Introduction
Accurate location of the physics is important in many pediatric orthopaedic operative procedures. Pre-operatively the physis can be identified by a simple plain radiograph of the specific part. Intraoperatively a C-arm Image Intensifier serves as an essential equipment for localizing the physis. Both in a plain x-ray and a C-arm image, the physis is visible as a radiolucent area sandwiched between the epiphysis and the metaphysis.
However, when the C-arm is not available as in a developing Institute like ours, necessity becomes the mother of improvisation. Ours is a Pediatric Institute, and we get a large number of cases where the accurate location of the physis is a must during the operative procedures like growth modulation (epiphysiodesis). The following series of cases describes how we accurately located physis per-operatively without the availability of a C-arm.

## Methods
The study was conducted at a tertiary-level pediatric institute between October 2017 and December 2018. Cases of uniplanar deformity around the knee attending the Orthopaedic outpatient department were enrolled for the study. The cause of deformity was assessed by a clinico-radiological and biochemical workup. Before planning deformity correction, the normalization of biochemical markers of rickets i.e. serum calcium, serum inorganic phosphorus, serum vitamin D levels and serum alkaline phosphatase was done by medical treatment over 3-6 months. Inclusion criteria included patients where physis was open and

sufficient growth was remaining (Figure 1). For this, skeletal age was estimated using wrist, pelvis and elbow radiographs. "Multiplier" android application developed by Rubin Institute of Advanced Orthopaedics, Baltimore was used to assess remaining growth. Deformity correction was planned by growth modulation surgery. It was decided to do a distal femoral medial temporary hemi-epiphysiodesis using an 8-plate in cases of Genu Valgum (CORA at the lower end of the Femur). However, due to the unavailability of the C-arm, per-operative accurate localization of the physis was a challenge.


**Fig 1:** Case of genu valgum with open physis

To overcome the difficulty of accurately localizing the physis taking a preoperative marker film was contemplated, as was usually done previously for spinal operations to localize the vertebral level. The choice of marker had to be such that it would be radio-opaque and would also persist on the skin per-operatively even after scrubbing, prepping and painting the part for operation. Henna paste was applied using a easily available cone in the form of a numbered grid till it dried, which usually takes 1 to 3 hours (Figure 2 and 3). The grid was made keeping in mind the anatomical bony landmarks around the knee from the lower third of the thigh to the upper third of the leg. Henna stains the skin and a well-stained mark persists for several days to a few weeks. The marker film was shot, instructing the radiographer of taking a normal exposure on a film 14 x 17 inch size and giving a print in true size i.e. without any positive or negative magnification (Figure 4). Peroperatively the marker grid on the radiograph was correlated with the marker grid on the skin to accurately localize the physis.


**Fig 2:** Commonly available henna cone

**Fig 3:** Preparing the numbered grid by using henna paste


**Fig 4:** Marker film

Further, per-operatively the physis can be roughly identified by a leash of transversely placed vessels at the epiphysis abutting the physis and arising from the passing main artery. Accuracy of preoperative localization of physis is increased by using a 1 mm thickness Kirschner wire, which when poked into the physis slips in easily, while it does not on the adjoining bone (Figure 5). Chances of error are further reduced by using a larger plate as the eight plate is available in three sizes – small, medium and large (Figure 6).

**Fig 5:** Intraopertive localization of physis using radio-opaque henna grid and thin kirschner wire

**Fig 6:** Eight plates of various sizes

## Results

There were eleven cases in the study. Nine were females and two were males. The mean age at presentation was 9 years (range 7 to 12 years). Three cases had unilateral affection, while eight cases had bilateral affection. Ten cases had genu valgum, while one had wind-swept deformity i.e. one-sided genu valgum and contralateral genu varum. Nine cases were diagnosed as nutritional rickets, while two cases were diagnosed to have hypo-phosphatemic rickets.

All cases had their deformity corrected till the last follow-up. Average follow-up period was 30 months (range 23 months to 36 months). Post-op check x-ray of depicted case is illustrated in Figure 7 and clinical photograph after correction of deformity is depicted in Figure 8.


**Fig 7:** Post-operative check x-ray

**Fig 8:** Clinical photograph after deformity correction

## Discussion

Pre-operative skin marking is a widely accepted and practiced as a part of pre-operative planning done by surgeons, especially plastic surgeons and vascular surgeons. It is helpful in planning incisions and mark the site of vessels, nerves, proposed flaps. It is also used by oncolgists for marking the site prior to radiotherapy. Varieties of intra-operative skin markers have been used, details of which are available in the literature. Autologous blood has been used in limited instances as an intraoperative marker. Triphenylmethane dyes like eosin, methyl rosalinium chloride (gentian violet B, crystal violet), Metbromin (Mercurochrome), and Patent Blue V have been used as a surgical skin marker for over a hundred years.[1] Use of Indigo carmine, methylene blue, Kirschner's solution (mixture of violet, Sudan blue and chloroform), iron gall ink (pyrogallol and iron chloride) and aniline-based dyes (with silver nitrate aqueous or alcohol base) have gone out of repute either due to potentially harmful effects or due to unavailability of pharmacological grade solution [1].

Various felt-tipped marker pens are commercially and widely available. They are durable skin markers that withstands the necessary vigorous surgical skin preparation on the theatre table, minimises confusion and the risk of mistakes occurring peri-operatively, as well as assisting the surgeon, especially in planning skin incisions [2]. They are available as permanent (longer lasting), non-permanent (easily erasable) and in various colours [3]. However, these are not radio-opaque.

The use of henna (mehendi) as a durable skin marker has also been reported in the literature. Its use has been advocated as a skin marker for simply localizing the side of surgery and the anatomical site [4]. It has been also used extensively by surgeons to mark stoma sites, sites of liver aspiration, perforators while planning varicose surgery, inguinal hernia sites, and marking of breast, prior to surgery for breast disease [5, 6]. Plastic surgeons have used it to plan perforator-based flaps by marking perforators using doppler ultrasound preoperatively [7]. It has been used by radiation oncologists as a skin marker to increase the accuracy of radiation therapy [8, 9, 10].

Its use as a pre-operative skin marker in orthopaedics has been suggested for localizing vertebral levels during spine surgeries [11]. This uses the properties of henna as a radio-opaque marker. Percutaneous injection of PMMA bone cement has also been used as a radio-opaque marker to localize vertebral levels during spinal surgeries [12].

Henna is prepared as a paste by crushing of the green leaves of the plant *Lawsonia inermis*, which has many medicinal properties. It is known in the Indian subcontinent as *Mehndi* and has been used since time immemorial to dye hair and for decorative art on hands and feet [13]. On staining, it leaves a reddish-brown colour of varying darkness depending on the

duration of contact. Although henna has been reported to cause hemolysis in patients with Glucose-6-phosphate dehydrogenase enzyme deficiency and additives like P-phenylenediamine (PPD) which is often added to henna to impart black color has been reported to cause allergic reactions in sensitive individuals; these are not common [14-16]. Hounsfield unit (HU) scale is a linear transformation of the original linear attenuation coefficient measurement into one in which the radiodensity of distilled water at standard pressure and temperature (STP) is defined as zero HU, while the radiodensity of air at STP is defined as -1000 HU[17]. Radiodensity of fat varies between -120 to -90, of bone between +300 to +1900, while that of blood between +13 to +100. Radiodensity of henna has not been reported in available literature and needs to be ascertained. Also, further studies need to be undertaken to establish increasing of radiodensity of henna paste by adding small quantities of pharmacological concentrations of contrast media used in radiographic studies [18].

## Conclusion

Henna is a near ideal pre-operative skin marker as it is easily available, inexpensive, visible even after vigorous surgical skin preparation and normally has no untoward side effects. Our use of henna in pediatric orthopaedic surgeries for localizing the physis has not been reported in the literature as of date. The purpose of presenting this case series is in no way to encourage replacement of C-arm and promote our improvised technique, but to inspire young orthopaedicians to overcome hurdles in day-to-day clinical practice and find means and ways to continue innovating.

## References


1. Kneilling M, Breuninger H, Kastl A, Heeg P, Hafner HM, Rocken M *et al*. Methods of labeling skin surgical specimens. Journal der Deutschen Dermatologischen Gesellschaft. Wiley 2009;7(10):871–6.
2. Tatla T, Lafferty K. Making your mark again in surgery. Ann R Coll Surg Engl 2002;84(2):129-130.
3. Bathla S, Nevins EJ, Moori PL, Vimalachandran D. Which pen? A comparative study of surgical site markers. Journal of Perioperative Practice. SAGE Publications 2018;28(1-2):21-6.
4. Ramana B. Henna as a Durable Preoperative Skin Marker. World Journal of Surgery. Springer Nature 2010 14;35(2):316-7.
5. Mehendale VG, Chaudhari NC, Shenoy SN, Mehendale AV. Henna as a durable preoperative skin marker. World J Surg 2011;35(2):311-5.
6. Griffiths A, Murphy F. The use of henna as an alternative skin marker in breast disease. Radiography 2012;18(4):279-86.
7. Puri VA, Mahendru S, Rana RE. Use of henna as a skin marker. J Plast Reconstr Aesthet Surg 2006;59(10):1123-4.
8. Rathod S, Munshi A, Agarwal J. Skin markings methods and guidelines: A reality in image guidance radiotherapy era. South Asian J Cancer 2012;1:27-9.
9. Rafi M, Tunio MA, Hashmi AH, Ahmed Z. Comparison of three methods for skin markings in conformal radiotherapy, temporary markers, and permanent Steritatt CIVCO tattooing: patients' comfort and radiographers' satisfaction: peer reviewed opinion article. South African Radiographer 2009;47(2):20-2.
10. Wurstbauer K, Sedlmayer F, Kogelnik HD. Skin markings in external radiotherapy by temporary tattooing with henna: improvement of accuracy and increased patient comfort. Int J Radiat Oncol Biol Phys 2001;50(1):179-81.
11. Thora A, Bhatnagar N, Tiwari A, Lingaiah P, Rustagi N. Use of henna as a durable pre-operative skin marker for accurate localisation of vertebral level in spine surgery. Int J Res Orthop 2017;3:461-5.
12. Hsu W, Sciubba DM, Daniel Sasson A, Khavkin Y, Wolinsky JP, Gailloud P *et al*. Intraoperative Localization of Thoracic Spine Level With Preoperative Percutaneous Placement of Intravertebral Polymethylmethacrylate. Journal of Spinal Disorders & Techniques. Ovid Technologies (Wolters Kluwer Health) 2008;21(1):72–5.
13. Agarwal P, Alok S, Verma A. An update on Ayurvedic herb henna (*Lawsonia inermis* L.): a review. Int J Pharm Sci Res 2014;5(2):330-39.
14. Kok AN, Ertekin MV, Ertekin V. Henna (*Lawsonia inermis* Linn.) induced haemolytic anaemia in siblings. Int J Clin Pract 2004;58:530-2.
15. Zinkham WH, Oski FA. Henna: a potential cause of oxidative hemolysis and neonatal hyper-bilirubinemia. Pediatrics 1996;97:707-9.
16. Lauchli S, Lautenschlager S, Lauchl S. Contact dermatitis after temporary henna tattoos – an increasing phenomenon. Swiss Med Wkly 2001;131:199-202.
17. Wikipedia contributors. Hounsfield scale. Wikipedia, The Free Encyclopedia 2019. https://en.wikipedia.org/w/index.php?title=Hounsfield_scale&oldid=894204057
18. Wikipedia contributors. Barium sulfate suspension. Wikipedia, The Free Encyclopedia 2019. https://en.wikipedia.org/w/index.php?title=Barium_sulfate_suspension&oldid=869964902.