

Neuroanatomy of the Pedunculated Accessory Digit

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Abstract: *Aim of the study:* There is clear evidence that a painful procedure in infancy is detrimental to pain response in later life. One such painful procedure is ligating pedunculated accessory digits (PAD) with 2-0 silk ties. This ligation is often done without oral analgesics or local anesthesia after birth. Neonates invariably appear to be in pain during this procedure. An anatomical study is carried out to assess the innervation of these anomalous digits. *Method:* Over four years (Dec 2011- Jan 2016), 12 infants older than 6-months of age underwent excision of 14 PADs. The digits were obtained after removing them under general anesthesia. PADs were fixed in formalin, mounted in paraffin, and cut in cross-section. The sections were processed and stained by standard nerve staining techniques. *Main Results:* The narrowest part of the pedicle contains central blood vessels and one large, myelinated nerve bundle that distally fan out to supply the finger. PADs have similar neuroanatomy to a normal digit. *Conclusion:* It is recommended before excision of a PAD that local anesthesia should be injected (or applied topically) to its base. A tie can then be applied to the pedicle, and the SD excised distal to it.

Keywords: Accessory digits, Neonatal pain, Local anesthesia, Neuroma.

INTRODUCTION

Polydactyly is a congenital digital anomaly of the hand and foot. It may be noted by parents or paediatricians, in isolation, or association with other congenital disabilities [1, 2].

Post-axial extra-digits (accessory) of the hand are commonly referred to as accessory digits. They can be bilateral and mainly consist of a vestigial appendage on the ulnar side of the hand [3].

Post-axial digits are managed according to the calibre of its base

A) Wide-based accessory digit: This is a minority of accessory digits (Fig.1). They are surgically removed at 6-9 months of age under general anesthesia.

B) Pedunculated accessory digit (PAD): Most extra digits fall in this sub-type (Fig.2). It is often tied off after birth, near its base with 2-0 silk ties, with or without local anesthesia. The digit undergoes ischaemic necrosis and detachment within a few days.

Neonates are invariably inconsolable and appear in pain for a few hours, mainly if a local anesthetic is not applied. The neuro-anatomical study is carried out to outline the precise location of the nerves in PADs.

MATERIALS AND METHODS

A small group of parents did not consent for immediate ligation at birth of PAD for personal reason and opted for delayed surgical excision under general anesthesia. Twelve infants, including 2 with bilateral PADs, were referred for excision over four years (Dec 2012- Jan 2016).

The SDs was removed in one piece, and the narrow stump was sutured with 5-0 absorbable sutures. The tissue was fixed in 10% formalin for 7-10 days and cut in cross-section every 2 mm. 4-micron sections were obtained and

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stained with Linder's silver nerve stain specific for peripheral nerves [4]. Additional slices, for further confirmation, were stained with calmodulin and troponin C (S100) immunohistochemically technique [5].

The parents were contacted telephonically five years later to assess for neuroma formation and tenderness at the scarred area of the hand(s).

RESULT

Neuroanatomy of PADs was identical in all 14 digits. The narrowest part of the pedicle contains central blood vessels and one large, myelinated nerve bundle (Fig.3).

This digital nerve, almost immediately, divided, resulting in 2 myelinated nerve fibres more distally in the pedicle (Fig.4). Small nerve fibres branch off at intervals.

The primary nerve bundles then fan out to their most distal section (Fig.5). This would indicate that all PSDs have neuroanatomy, much like a standard digit.

Ten parents were available telephonically for a follow-up interview, and all confirmed a barely visible scar and no sensation anomaly around the stump remnant (Fig.6).



Fig-1: A broad base post-axial accessory digit (black arrow)



Fig-2: A narrow base post-axial accessory digit (white arrow)



Fig-3: Nerve stain of the base of the digit; a large, myelinated nerve is shown (black arrow)

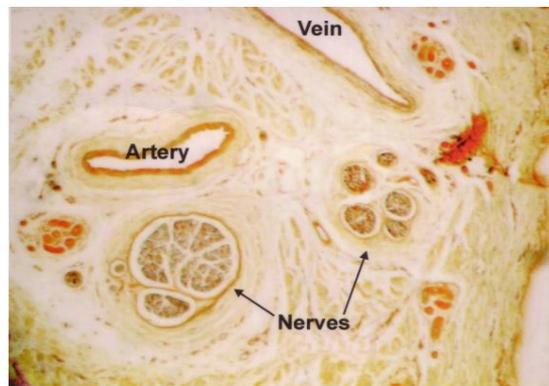


Fig-4: Nerve stain of mid-digit; multiple myelinated nerves are shown (black arrows), artery and vein are named separately

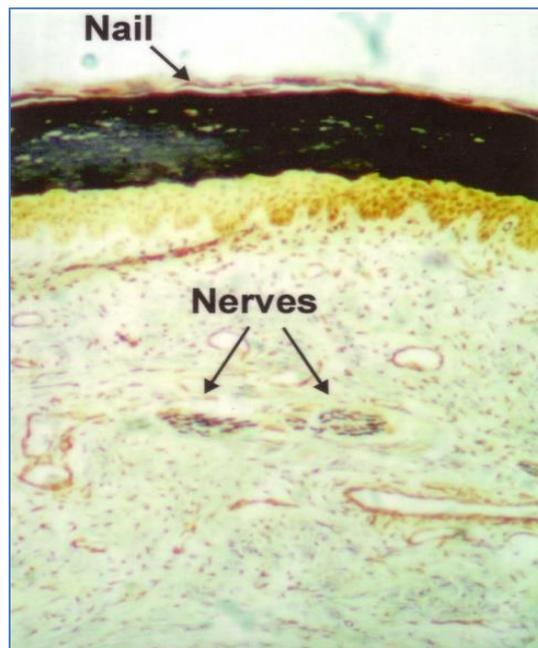


Fig-5: Nerve stain nears the distal end; tiny nerve fibers are shown (black arrow). Nail is named separately near the top of the figure



Fig-6: Skin remnant of the stump in a seven-year-old boy (black arrow), no neuroma formation noted

DISCUSSION

Polydactyl is one of the most frequent congenital digital abnormalities. It is often noted in isolation or as part of other congenital disabilities, such as cranial malformation (1). Its incidence is 1:1000; it is equal in males and females but ten times higher in the black population [2].

Polydactyly is classified into pre-axial, central and postaxial types:

Pre-axial polydactyly, the most common type, refers to the duplication of the first digit. When central polydactyly is noted, it involves duplication of the second, third, or fourth digit.

Post-axial polydactyly, which is often pedunculated, involves the fifth digit or metacarpal area [3]. Genetically, an autosomal dominant type exists, and it has been associated with glioblastoma (GLI3) gene. This gene is a transcriptional repressor factor which is involved in developing digits [6].

There is increasing evidence of atypical pain perception by older children exposed to surgical procedures without adequate analgesia during infancy [7]. The pathophysiology remains unknown but is postulated to be due to abnormal neuronal development in neonates exposed to excessive painful stimuli [8]. Indeed, reports suggest an increased risk of brain damage in ex-premature infants subjected to painful stimuli [9].

The most performed painful procedure is male circumcision. Despite many published reports on different methods, timing, and importance of adequate analgesia for circumcision [10], no similar report could be found on appropriate pain relief for removal of PADs.

There is no information on the exact nerve supply of PADs in the literature. For decades, it has been an established practice that a permanent suture (2-0 silk) could be applied the base of PAD in the neonatal period; it is done without any form analgesia.

As noted in this study; staining of PAD's tissue suggests that its neuroanatomy resembles the nerve supply of a standard digit.

CONCLUSION

It is recommended that before removal of a PAD, local anesthetics should be injected (or applied topically) to the base of the digit.

A tie can then be applied to the pedicle, and the PAD excised distal to it after a few minutes. A surgeon should preferably perform the procedure as bleeding from the single central artery can be troublesome. Occasionally, a digital nerve can be identified; it can be extracted by a few millimetres, and divided sharply allowing it to retract. This will prevent neuroma formation [11].

Ethical approval was obtained by local review committee: International Review Board (IRB) number Board #0001223

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