Evaluation of the Plane Shaped Flap in Reconstruction of Congenital Hand Syndactyly

Haider Abdulkareem Jasim*, Sabah Hasan Naji**

ABSTRACT:

BACKGROUND:

Time consuming, scar contracture, web creeping is risks with reconstruction by skin graft. dorsal metacarpal flaps minimize these complications however they still occur. This study is based on a plane-shaped advancement flap on the dorsum of the hand and a traction device for webspace to prevent contraction and creeping.

THE AIMS:

To evaluate the primary closure after releasing of tight syndactyly and minimizing creeping and contracture of Webspace

PATIENTS AND METHODS:

From January 2018 to May 2019 ten patients (10 Webspaces), 3 females and 7 males, age ranged (1-19) have congenital tight hand syndactyly (3 complexes, 5 simple incomplete,2 simple complete) .

RESULTS:

Average time of operation was 60 min , primary closing of all incisions was done . one of the ten patients had hypertrophic scar at donor site of the flap. furthermore , four patients had web creeping ,one of them had epidermal sloughing of the flap, the others had creeping .

CONCLUSION:

Dorsal advancement plane-shaped flap is helpful in reconstruction tight syndactyly However, it needs precise dissection . Some patient haven't compliance with traction devices so it isn't corresponding for every patient

KEYWORDS: Tight syndactyly, Plane shaped flap, Webspace creeping.

INTRODUCTION:

Syndactyly is the second most common congenital hand abnormality that tends to affect male more commonly than female with 1/2000 incidence. In about 50% of all cases, it occurs bilaterally with the third webspace is most commonly affected. Syndactyly had both aesthetic and functional impact on the children , it may cause severe impairment with growth disturbance or may have little functional effect . syndactyly lead to multiple emotional feeling to parents of an affected child including anger ; disappointment, anxiety about their children. [1,2,3]

The surgical operation to correct syndactyly is not urgent and its aim to correct both function and appearance . early intervention should done when border digit are involved as this cause significant impaction on growth , same applied to thumb-index fusion and complex type of syndactyly . surgical reconstruction of syndactyly depends on the severity of the condition. Most procedures used the dorsal skin flap for reconstruction of commissure , however most cases needed skin graft.[4,5,6]

Many modifications had been proposed for commissure reconstruction without need for skin graft including trapezoid shaped flap, island flap , proximal based dorsal rectangular flap , trilobed flap and other.[7]

In this study dorsal plane-shaped advancement flap had been used for webspace reconstruction in congenital syndactyly without using of skin graft in consist with Juan Liu et al .[8]

PATIENTS AND METHODS:

Between January 2018 and May 2019, 10 patients presented with congenital syndactyly of the hand, their ages ranged between(1-19 years) with mean age is 10 year old . They were admitted at Al-Wasity teaching hospital .patients were surgically treated using dorsal plane-shaped advancement flap for finger Webspace reconstruction without using skin graft. The follow up period was 6-12 months. The patient data is shown in table 1.

* AL-Wasity Teaching Hospital. Baghdad, Iraq
**Consultant Plastic Surgeon, AL-Wasity Teaching Hospital, Baghdad, Iraq

Table 1: Patient data.

Patient number	Gender	Age (years)	Involved hand	Involved Webspace	Type of syndactyly
1	Male	1	Left	third	Complex
2	Male	2	left	third	Simple complete
3	Male	6	right	second	Simple incomplete
4	Female	3	left	third	Simple complete
5	Female	4	right	third	Simple complete
6	Male	7	right	third	Simple incomplete
7	Male	6	left	third	Complex
8	Male	4	right	third	Simple complete
9	Female	16	left	second	Simple incomplete
10	Male	19	bilateral	Third	Simple complete

Exclusion criteria:

a) Complicated syndactyly(abnormal bone structure is found inside the syndactyly with fusion, rudimentary bone, missing bone, abnormal joints, and sometimes cross bones)
b) Adjacent syndactylized Webspaces
c) When dorsal metacarpal artery was not presented in Doppler study.
d) Supple syndactyly
e) We were used Withey et al. grading of web creeping after six months of follow up . (fig 1)

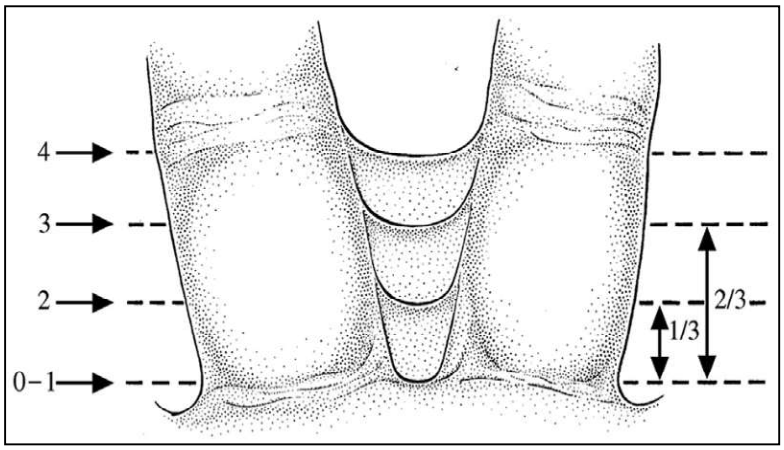

Figure 1(9) :- withy grading : grade 0 is soft web , abduction mirrors the adjacent web or equivalent web on other hand . grade 1is thicking of web without advancement . grade 2 is one third web creep recurrence of distance from palmar MCP crease to PIPJ crease. Grade 3 is two third web creep recurrence of distance from palmar MCP crease to PIPJ crease . grade 4 is web creep recurrence of the full extent from palmar MCP crease to PIPJ crease .

Operative technique:
marking volar and dorsal triangular flaps by drawing mirror image zigzag incision both palmary and dorsally, ensuring that the apex of each flap ends at the mid digital plane with 60-degree angle. Fig (2)

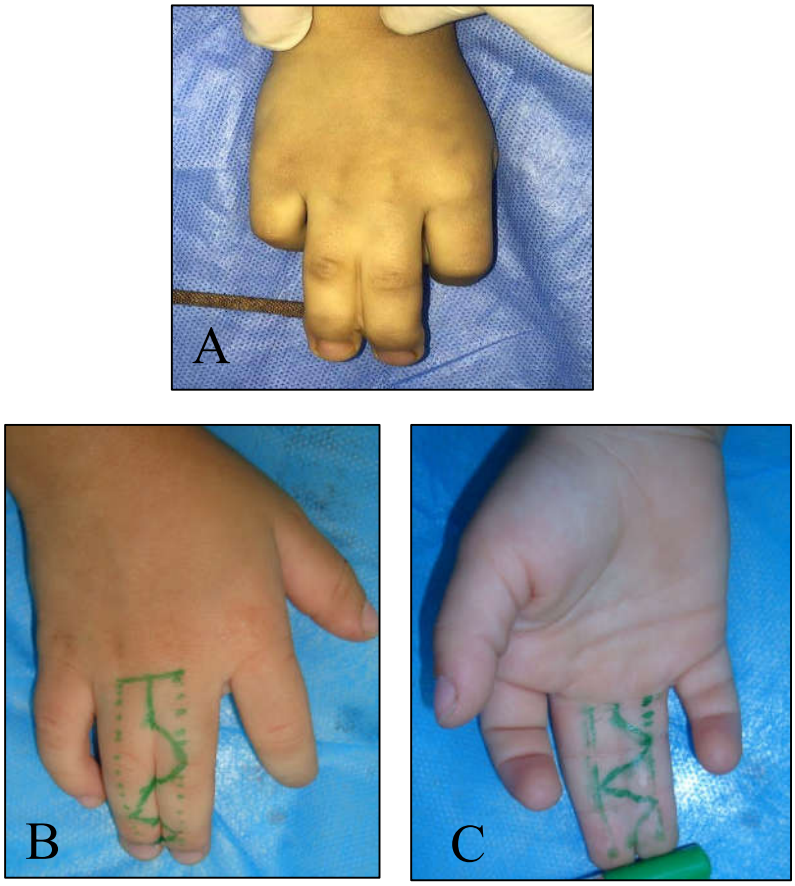

Figure 2: case no 8: A-preoperative view for complete third Webspace syndactyly.B,c preoperative marking of dorsally &palmar tringles flaps.

we incised previously marked dorsal and palmar interdigital flaps, dorsal flaps were raised first above the level of epitenon then volar flaps were raised with careful dissection and separation of the digit that proceed from distal to proximal. A bone cutter was used in case of complex syndactyly with bone fusion. After the flaps were raised, the length of Webspace defect was measured to ensure it would be same length of plane-shaped dorsal flap and the length and width of defect at inner sides of released digits were measured which was the same measures of wings . The plane shaped dorsal flap was marked as the hexagonal shape flap with length corresponding to length of Webspace defect and width corresponding to intermetacarpal space , two lateral wings equilateral triangles in shape that extended from the sides of flap which correspond to defect at the inner surface of proximal phalanx. The lengths to width ratio of the flap are preferred to be 3:1 to close the donor site without dog ear. The plane shaped flap was elevated by incising the borders of the flap and then the incision was gradually deepened to include adequate subcutaneous tissue within the flap. The flap was elevated from distal to proximal, keeping it attached to cutaneous perforator of dorsal metacarpal artery which emerges between the two head of metacarpal bones (fig.3).

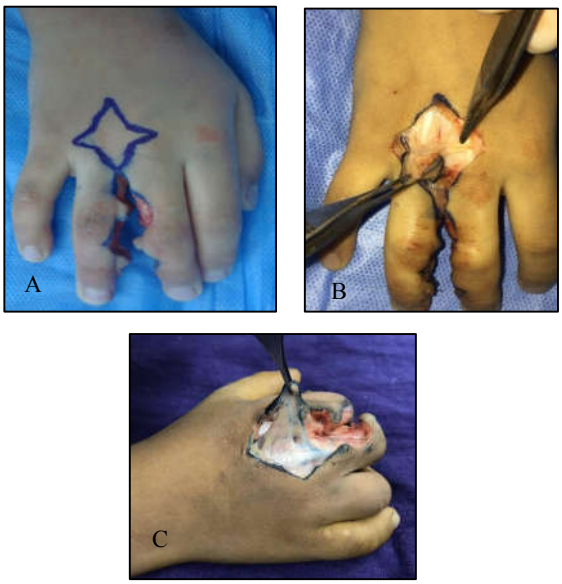

Figure 3:A- case no5;planning for the proposed location of plane shaped dorsal flap.B- Elevation of dorsal plane shaped flap from proximal side and showing the dorsal metacarpal artery. C-case no3;lateral view for the pedicle of flap

After completely freeing the flap, it was advanced distally and volarly throughout the new Webspace, with its apex sutured to the tip of palmar incision and the two lateral triangular wings were adjusted to the inner side wall defect of adjacent fingers. both volar and dorsal digital flaps were sutured to cover the rest of both digits.The donor site of the base of plane shaped flap on the dorsum aspect of the hand is closed . While the two lateral wings donor sites were closed primarily .The dressing was secured in position by crep bandage with c – shaped slap which was applied along the web in order to avoid adduction web contracture and creep. The c shaped slab was kept for at least 3 to 4 weeks postoperatively after which it is kept just at nights for 8 weeks. Rubber band as traction device was used at Webspace for 6 hours/day and for 6 months latter to minimize creeping . Patient were followed up period for up to 6-12 months postoperatively.

RESULTS:

Ten patients (10 syndactyly : 2 complex , 8 simple with 3 incomplete and 5 complete) were treated by using plane-shaped dorsal advancement flap for reconstruction of Webspace without using skin graft with average follow up period extended up to 6-12 months postoperatively. Six of our patients showed satisfactory results in terms of aesthetically acceptable Webspace with near normal inclination and with no web creep, flexor contracture or digital angulations .Patients and/or their parent satisfaction with postoperative results both aesthetically and functionally showed in (fig 4)

The complications: three cases out of ten have complications which included Superficial sloughing of flap, Hypertrophic scar of the donor site of the flap, Webspace creeping

Figure 4: case no 5 ; A- preoperativly.B-dorsal aspect of hand after 3 months from surgery .C- after 9 month of surgery and using traction device for 6 month. D- volar aspect of hand s . E- Webspace slopes . F- traction device G-distance measured from Webspace to PIPJ crease after 6 month.

DISCUSSIAN:

In this study , plane shaped dorsal advancement flap for Webspace reconstruction used in ten patients (10 Webspace syndactyly).one patient had epidermal flap sloughing , but all the flaps survived with no reported cases of complete flap necrosis, wound dehiscence or wound infection. The Webspace was closed by flap without need for skin graft . The resultant Webspace had satisfactory postoperative appearance with shape that was comparative to the adjacent normal space. No finger flexion, angulation or scar contracture occured. web creeping with withy grading 1 (thickening of the web without advancement) was developed in six cases out from ten cases 6 months postoperatively which was not affected the function of the Webspace ,two cases with grade 4(one of them who had the epidermal sloughing of the flap) and one case with grade 3and another one with grade 2creeping, those four cases weren't compliant with using c shaped slab and traction device. Marked improvement was reported in six patients out from ten in hand function compared to the pre-operative function. The donor site of the flap on the dorsum of the hand had an acceptable appearance after 6 month postoperatively except in one case who developed hypertrophic scar .

This result in general wasn't consistent with Juan liu et al[8]. Liu`s study suggested plane shaped

dorsal advancement flap for Webspace reconstruction in 20 patients (24 syndactyly) and their results showed that using this technique obviate the use of skin graft and the postoperative result showed aesthetically pleasing Webspace with normal deep and wide appearance with excellent postoperative function.

We utilized the Webspace traction device for prevention of Webspace contraction and creeping which was used previously by Harith A. Alani et al. for skin graft contracture in Webspace.(10)According to the reliable result which impacted directly to produce successful outcome in this study . By glance over the paper the results clearly show that applying the traction device on 31 Webspaces which have creeping after burned hand had magnificent improvement in cohort . However, 22% of them had developed creeping due to poor patient adherence to this method which has been experienced in this study again.

Using skin graft is inevitable in all cases of syndactyly, since it's necessary to cover the raw areas over the digits after syndactyly release. Both Eaton and Lister had observed that ratio of the circumference of affected digits both before and after release is 2/3, which means that the skin is not sufficient after release to cover both digits. In general skin graft usually needed in all cases of syndactyly (except minor case) as even in the simple type of syndactyly skin shortage was at least 36 % of circumference[11.12]..However, using skin graft of either split thickness or full thickness is associated with many complications like risk of graft loss, pigmentation, hair growth, scaring, contracture, web creep and rarely keloid formation[13]. It has been suggested that using skin grafts in Webspace reconstruction are associated with a high risk of web creep because of reduce intrinsic growth potential and the skin graft in contrast to flap, do not grow with child[14]. Due to the complications associated with the use of skin graft in Webspace reconstruction to surgically repair syndactyly, many authors have introduced different local flaps for web reconstruction. The basic idea is the rearrangement of local tissue as a flap to gain more skin and more distally placed for Webspace reconstruction [15].

Proximally based dorsal rectangular flap is the most widely used procedure for Webspace reconstruction however, with this method the linear scar that forms along palmar aspect of the Webspace may lead to contracture thus web creep[16]Many authors later advocated the use of dorsal arterial network to provide a flap that avoided the use of skin graft. These flaps are based on the perforator of metacarpal artery (direct cutaneous branch that arise from the dorsal metacarpal artery). The first authors described this flap are QUABA and DAVISON[17]. It was advocated by Sherif who used it in 21 syndactyl webs in V-Y fashion and also used by both AYDIN and OZDEN [18] but in form of transposition flap . FRICK et al. used it in form of dorsal omega flap together with combined palmar "anchor" incision [19] . Others have used in form of dorsal pentagonal advancement skin flap which joins with volar and dorsal triangular flaps .

In this study, dorsal metacarpal artery flap had been modified to plane shaped where two triangular wings had been added to each side of the hexagonal advancement flap, these provided adequate defect coverage of both sides of the digits with near normal configuration of the Webspace. No skin graft was needed in all the cases. Dorsal skin of the hand had good pliable elastic tissue that allowed to advance the flap to close the Webspace and closing the donor site without tension. The flap had consistent blood supply from the cutaneous perforators and from the dorsal metacarpal artery. In addition to that, the flap has good color, texture and minimal thickness which is matched to the adjacent digits therefore, there was good aesthetic appearance [20].

Other authors had described similar design of two triangular wings for example GAO et al. where they described dorsal pentagonal advancement skin flap for Webspace reconstruction in syndactyly treatment.However, this procedure lead to significant transverse scarring at the dorsum of the proximal fingers. The donor site of the wing is closed under tension which may lead to postoperative hypertrophic scarring[21].

GengizYildirim used dorsal V-Y flap and volar triangular flap for Webspace reconstruction however, the procedure still required additional skin graft in some cases and the same was applicable to simple incomplete syndactyly [8].

There is another flap which is based on dorsal skin of the proximal phalanx, an example of these flaps are the trilobed flap and seagull flap which can be used for Webspace reconstruction. However, these flaps had the disadvantage that its donor site needs skin graft [21].

Z- plasty can be used for Webspace reconstruction. Both Furnas and Fisher had showed that single z-plasty is more effective than multiple small z-plasty. However, z-plasty can be used for minor degree cases and had tendency of v-shaped appearance of Webspace. Use of double oppositing Z-plasty may produce a slight increase in depth and width of the Webspace which may lead to boxy appearance. The four-flap z-plasty is still only applicated for minor cases and there is risk of tip necrosis [22].

One of the alternative methods to provide Webspace reconstruction without using skin graft is excessive skin defatting of digit and inter digital space however, such aggressive defatting presents with a high risk of nerve and vascular injury which may jeopardize blood supply and may lead to thin digit because of involution of fat during period of child growth [21].

CONCLUSION AND RECOMMENDATION:

Dorsal – plane shaped advancement flap is one of solution for Webspace reconstruction. It provides Webspace with good color and texture . It avoid the use of skin graft in Webspace, therefore, reduces the complications associated with skin graft. It is less time-consuming procedure in comparison to using skin graft. The c-shaped slab was used to keep the wideness of Webspace but it wasn't made differences in result. Traction band can minimize Webspace creeping in some patients whose adherent to using it.

REFERENCE:

1. David warwick ,RoderickDunn,EvmanMelikyan, Jane Vadher. Oxford specialist handbooks in surgery: hand surgery,1st.ed.,oxford university press,U.K,2009:550.
2. Charles H. thorn .Grabb and smith`s plastic surgery .7th.ed.,wolterskluwer/ Lippincott Williams and wilkin , Philadelphia ,2014:892.
3. Gregory S. Georgiade, Ronald Riefkhol, L.scott Levin. Georgiade plastic & maxillofacial and reconstructive surgery .1st.ed., Williams and wilkins,Philadelphia,1997:978-50.
4. Jacques duprac .surgical technique in orthopaedics and traumatology ,1st.ed., Elsevier ,paris ,2000:182.
5. Kervin C. chung , Peter M. murvay. Hand surgery update , 1st.ed., American society for surgery of hand (ASSH).2011:291.
6. Terri m. skirven, A. lee oysterman , jane M. fedorczyk , peter C. amadio .Rehabilitation of the hand and upper extremity ,6th.ed., Elsevier mosby ,2011:642.
7. Scott W. wolf, Robert N. hotchickiss ,wiliamc.pederson , scott W. kozin , mark s. cohen . green`s operative hand surgery , 7th ed., Elsevier ,Philadelphia , 2017 :12-19.
8. Juan liuet.al .dorsal plane shaped advancement flap for the reconstruction of Webspace in syndactyly without skin grafting : A preliminary report , journal of plastic reconstructive and aesthetic surgery ,2015 ;68:e167-e173.
9. Withey SJ, Kangesu T, Carver N, Sommerlad BC. The open finger technique for the release of syndactyly. J Hand Surg Br. 2001;26:4-7.
10. Harith A. Alani , Ahmed Abdul Razzaq , Zakaria Y. Arajy. Webspace traction device: an effective way for the prevention of Webspace skin graft contraction .Eur J PlastSurg , 2012 ; 35:873–80.
11. Marios D. verkins et.al .congenital syndactyly : outcome of surgical treatment in 131 webs ,technique in hand and upper extremity surgery . 2010;14:1-7 .
12. Ross D.farhadlen ,neilbulstrode Sabrina cugeno .plastic and reconstructive surgery : Approaches and technique,1st ed. ,wiley ,U.K ,2015:664 .
13. Yi-jialim, Lam chuan Teoh, EngHinLee . Reconstructive of syndactyly and polydactyly of the toes with dorsal pentagonal island flap : A technique that allow primary skin closure without use of skin graft , the journal of foot and ankle surgery .2007;46: 86-92 .
14. N.S Niranjan , S.M. Azad , A.N.M. fleming ,S.H. liew. Long term results of primary syndactyly correction by trilobed flap technique , The British Association of plastic surgery ,Elsevier Ltd ,2005;58:14-21.
15. Xiaofei Tian et Al. single stage sepration of 3- and 4- finger incomplete simple syndactyly with contiguous gull wing flaps : A technique to minimize or avoid skin graft , J hand surgery Am. , 2017 ;42 :257-64.
16. Hajime matsumine et al. .improved " bell-bottom" flap surgical technique for syndactyly without skin graft , plast. Reconstr. Surg. . 2011;128:504e-9e .

17. Quaba AA,DavisonPM (1990) the distally based dorsal hand flap.Br J plast surg 43:28-39.
18. Aydin A, ozden BC dorsal metacarpal island flap in syndactyly treatment .Ann plast surg 2004;52:43-48.
19. Frick L, fraise B, Wavreille G, fron D, Martinot V Result of surgical treatment in simple syndactyly using commissural dorsal flap: About54 procedures . chir main 2008; 27:76-82
20. GengizYildrim et al. . correction of syndactyly using a dorsal separated V-Y advancement flap and a volar triangular flap in adults ,annals of plastic surgery ,2011;67:357-63.
21. Weiyang Gao et al. .dorsal pentagonal local flap: A new technique of web reconstruction of syndactyly without skin graft , Aesthplastsurg ,2011;35:530-37.
22. OnderTan ,BekirAtik , DuygnErgen . versatile use of the VM- plasty for reconstruction of the Webspace , Annals of plastic surgery ,2005;55:623-28.