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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/16050
DOI URL: <http://dx.doi.org/10.21474/IJAR01/16050>



RESEARCH ARTICLE

DUFOURMENTAL FLAP RECONSTRUCTION, REVIEW AND MODIFICATIONS

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Manuscript Info

Manuscript History

Received: 20 November 2022

Final Accepted: 24 December 2022

Published: January 2023

Key words:-

Dufourmental Flap, Limberg Flap,
Rhomboid Flap

Abstract

Objective: The aim of this study is to present our clinical experience and suggest possible modifications of Dufourmental flaps.

Materials and Methods: In our study thirty four patients operated for different pathologies with reconstruction done by Dufourmental flap July 2021 to December 2022.

Results: Twenty-one of the 34 cases were male and the median patient age was 44.2 years. Nine cases were operated on under general anaesthesia and 25 were performed under local anaesthesia. In 20 cases the pathology was benign 10 cases the pathology was malignant and in rest four cases the defect was post-traumatic two among those were secondary to the dog bite. None of the patients has partial or total flap loss, one patient has margins positive on biopsy.

Conclusion: Dufourmental flap although a local flap is very versatile flap and can be safely used in wide spectrum of defects and almost all areas of body. This flap can be easily tailored to meet the specific needs of the patient.

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Introduction:-

Dufourmental flaps are geometric local transposition flaps, a modification over Limberg flap, and offer added versatility within the Reconstructive surgery. This flap is most commonly used to cover post-resection skin defects as well as post-trauma tissue loss. In both types of rhomboid flaps successful outcomes have been reported in a range of anatomical locations and pathological defects such as post resection soft tissue defects in malignant and benign lesions, post traumatic soft tissue loss, burn contractures, chronic pilonidal sinuses, hand, and breast reconstruction [1][2][3]. This flap takes advantage of skin laxity adjacent to the defect to allow the transposition of tissue with similar characteristics to the tissue excised. This can allow a superior cosmetic outcome when compared with skin graft reconstruction [4]. A rhombus is a special case of a parallelogram, and is a four sided quadrilateral. In a rhombus, opposite sides are parallel and the opposite angles are equal. Moreover, all the sides of a rhombus are equal in length, and the diagonals bisect each other at right angles. The term 'rhombic' is, therefore, most accurately used to describe flaps resembling a rhombus, and while 'rhomboid' is for those resembling a rhomboid or parallelogram. The rhombic flap was first described by the Russian surgeon Alexander Limberg in 1945 and published in English in 1966 [5]. The flap was designed adjacent to the defect with a corresponding shape to allow for easy transposition.

Claude Dufourmental in 1962 modified the Limberg rhombic flap with a more acute angle and modified shape allowing for flexibility of design and ease of closure (6). Firstly, when designing the defect (Figure 1), the acute angle (alpha) may have a range of 60-75 degrees.

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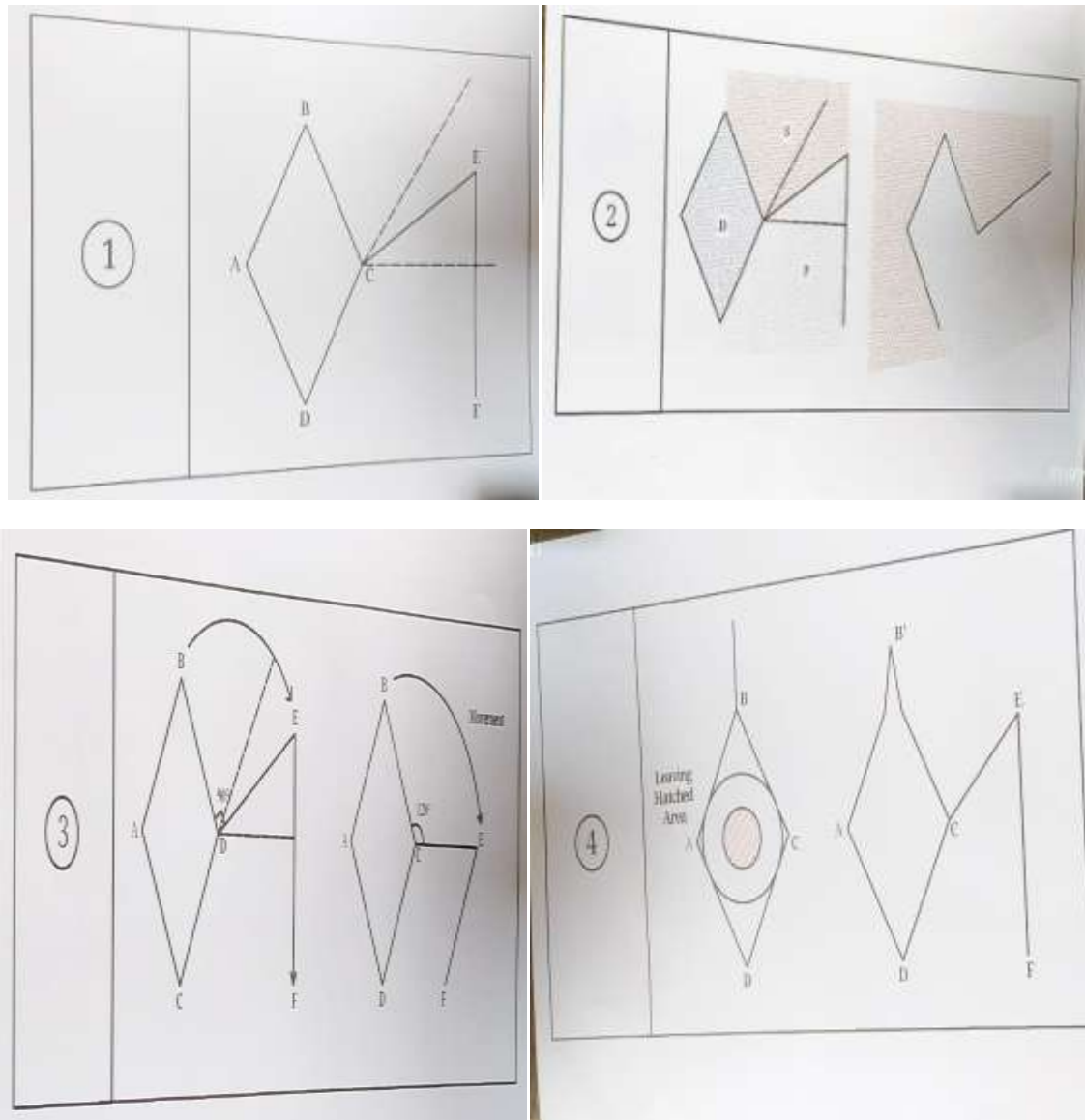


Fig 1-4:- Geometry of Dufourmental Flap.

The flap itself is designed by aligning the first incision (CE) as the bisection of the angle between the line of the short diagonal axis of the rhombus defect (AC) and the line of its adjacent side (DC). The flap angle (beta) may equal the defect angle (alpha) or decrease if necessary, allowing further flexibility. Advocates claim superiority over the Limberg flap in terms of improved blood supply and ease of donor site closure through the use of a wider pedicle width and a more flexible design [2][6][7]. The adaptability for surgical resection and reconstruction has been reported to be superior to the Limberg flap by Sebastian et al. in the context of chronic pilonidal disease [8].

Anatomy

The Dufourmental flap and other local random pattern flaps derive their blood supply from the subdermal plexus which is present at the junction of the reticular dermis and subcutaneous layers. Arterioles pass superiorly from this plexus to supply the dermis and epidermis via dermal and subepidermal plexuses (9). The subdermal plexus provides the base for the vascularity of local flaps without the need for axiality, however, the inclusion of a small cuff of subcutaneous fat is an absolute minimum to preserve the subdermal plexus. Pre-surgical planning is done to transpose the flap from an area of maximum laxity around the defect, with attention to relaxed skin tension lines or Langer lines. The rhombic flap should be oriented such that the short diagonal axis of the flap is perpendicular to relaxed tension skin lines.(10) In the head and neck regions particular attention should be given to preserving the

division between aesthetic subunits. The placement of incisions in existing creases and borders between subunits leaves the least conspicuous scar (11). Adjacent facial landmark structures should always be considered while distributing tension to avoid distortion, especially in the infraorbital region to prevent ectropion (10).

Technique

In the case of resection of skin malignancy, the first step is to mark the lesion followed by the resection margin. This is followed by making a rhombus with equal opposite angles having the small angle between 60 to 75 degrees. Consideration is given to factors described earlier the area of maximum skin laxity, the subunits of the face and Langer lines, and the best possible orientation chosen among the various probabilities. It is to be kept in mind that short diagonal should be parallel lines of maximal extensibility (LMEs) and perpendicular to the relaxed skin tension lines (RSTLs) or Langer lines. The Langer lines may be identified by existing skin creases or wrinkles, although a pinch test may be performed if there is uncertainty. The final option also depends on proximity to neighboring landmarks and the aesthetic subunits. This should be drawn out with a surgical marker, after making the rhombus short diagonal (AC) is extended into the direction of the tentative flap, this is followed by the extension of the side of the rhombus which is planned adjacent to the base of the Dufourmental flap (DE). The two extended lines are bisected by third line (CE) and this line forms the border of advancing edge of the flap. The length of this line is kept equal to the side of the rhomboid (AB). From the end of the line, another line parallel to the long diagonal of the rhombus is drawn back thus outlining the flap (EF). It must be noted that angle CEF is varied and may be altered based on the need and experience of the surgeon, furthermore length of CE may be kept more than AB and the extra flap may be adjusted by bisecting the angle ABC. The said modification can be used in big defects and in areas where mobilization of flaps is difficult as in the scalp, the manoeuvre effectively converts BCE as a mobile secondary flap (S).

Materials and Methods:-

The study population consisted of 34 patients with post-resection or post-trauma defects on any areas of the body covered with Dufourmental flap or any of its modifications between July 21 and December 2022. There was no limitations regarding etiology, location, size, age, sex, or any other patient factors. Each patient was informed about the operation and informed consent taken. Age, gender, body mass index (BMI), duration of the symptoms, previous irradiation, previous trauma, and length of hospitalization were recorded. Patients were evaluated in terms of the operative time, postoperative complications (including infection, flap edema, wound dehiscence, seroma formation, flap necrosis, and maceration), recurrence rate, return-to-work time, and cosmetic satisfaction.

Indications

Small to medium-sized defects which cannot be primarily closed may be reconstructed with Dufourmental flap. The flap offers the advantages of being a local flap which include excellent colour match, texture match, and avoidance of skin graft.

Contraindications

Inadequate oncological clearance may be considered an absolute contraindication of the local flap, so in some situations delaying until oncological clearance or till Mohs micrographic surgery can be performed. The flaps may be difficult to raise in previously irradiated areas of the body and in case of trauma if the surrounding area comes in the zone of trauma with multiple surrounding scars. Heavy smoking and poorly controlled diabetes anticoagulants may be considered relative contraindications.

Results:-

The study was conducted for a period of 18 months from July 2021 to December 2022 at Govt. Superspeciality Hospital Srinagar. A total of 34 patients were included in the study, the patients ranged from having benign lesions, and malignant lesions to post-traumatic defects. Twenty-one of the 34 cases were male and the median patient age was 44.2 years. Nine cases were operated on under general anesthesia and 25 were performed under local anesthesia. In 20 cases the pathology was benign 10 cases the pathology was malignant and in rest four cases the defect was post-traumatic two among those were secondary to the dog bite. None of the cases was sacrococcygeal pilonidal sinus as these cases are performed in the general surgery department at our center. One patient had a margin positive in resection it was dealt with excision of the suture-line and advancement of the flap, the outcome was excellent (Case 4). None of the patients had complete or partial loss of flap. All of the patients have an excellent cosmetic outcome.

Case 1

A 45-year male patient with post-dog bite soft tissue defect right buccal area of the face inferiorly based Dufourmental flap designed and flap transposed into the defect. A satisfactory outcome was achieved. Figure A1-4



FIG A1- A4:- Post dog bite reconstructed by Dufourmental Flap.

Case 2

A 65-year-old male patient had a post-dog bite soft tissue defect on left temporal area the size of the defect was about 5 by 6 cm. Initially grafting was planned however ultimately Dufourmental flap was done to cover the defect without the need for grafting. The flap was designed with the incorporation of the left superficial temporal artery posterior branch, which allowed more freedom in the design of the flap. The flap was designed long than the conventional design and the angle was kept more acute, this allowed for more movement of the secondary flap(S). Figure B1-4.



FIG B1- B4:- Large Scalp defect reconstructed by Dufourmental Flap.

Case 3

A 27-year-old female patient was operated on the right side of her face, for superficial spreading squamous cell carcinoma. The flap designed was superiorly based on the right buccal region of the face. While designing the angles of the flap were marked as the soft curved and short diagonal of the rhombus was kept parallel to lines of maximal extensibility (LMEs) and perpendicular to the relaxed skin tension lines (RSTLs) or Langer lines. The outcome was excellent. Figure C1-2.



FIG C 1- C2:- SCC Face.

Case 4

A 35-year-old female presented with biopsy-proven SCC right lower eyelid. WLE was done with a cover with Dufourmental flap from the nasolabial area. The patient had positive margins on biopsy the suture line was excised again after 6 weeks patient had an excellent outcome. Figure D1-3.



FIG D1-D3:- SCC with excellent cosmetic outcome.

Case 5

A 43-year-old male patient was operated on because of a BCC over his right temple. The defect closed with Dufourmental flap with an excellent on-table cosmetic outcome. Figure E1-2.



FIGE1- E2:-

Case 6

A 64-year-old male patient case of Basal cell carcinoma right lower eyelid. Medially based Dufourmental flap was raised, inset was made without any surrounding distortion. Figure F.





FIG F1- F4:-

Discussion:-

The Dufourmental flap has several advantages over the Limberg flap, one being that we are using two flaps one being the primary flap other being the secondary flap between the primary flap and the defect. The secondary flap and undermining reduce the tension created by the movement of the primary flap. Neither flap is rotated to a large angle nor a long distance this translates into a good cosmetic outcome. Tissue compression (dog ears) around the points of rotation is minimal.

By altering the length and angle of the rhombus made around the resection margin various patterns of the flap can be possibly made, to alter the tension, angle, and final suture line depending on the situation. In addition to minimizing tension, this procedure results in a cosmetic defect that has a broken geometric appearance. Closures characterized by a broken geometric appearance are generally considered superior to those characterized by a straight line.

Strict mathematical analysis of Dufourmental flaps was done using geometric models the oversimplified versions of flap dynamics are difficult to apply to clinical situations. Tissue characteristics, local skin tension, age, the presence of aesthetically sensitive areas, presence of vital structures make all defects unique. As Lister and Gibson noted the precise prediction of flap movement under specific circumstances would require a computer rather than a plastic surgeon. (12)

The design of a Dufourmental flap allows for the closure of rhomboid defects of varied angles when compared to closure with a Limberg flap. The angles of the rhomboid do not need to equal 60° as in the Limberg flap. The small angle of the defect ABC is replaced by the smaller angle of the transposed flap CEF which is an advantage as it decreases the tension at the closure of the secondary defect. Unlike the Limberg flap, there is the transposition of two flaps as practically another flap is formed between the donor defect and the Dufourmental flap. (Figure 2) owing to a change in planning. The degree of rotation needed for the flap to reach the defect is decreased. In this case, if the rhomboid is 60-degree is decreased from 120 degrees to 90 degrees (30 degrees reduction in Dufourmental flap) (Figure 3). The movement of the flap needed to reach the defect is also reduced significantly by about 20 percent. (8.5 cm from 10.5 cm in case the defect size is 6 cm).

While excising malignancy with recommended resection margin, mark a rhombus for flap planning but leave the corners of the rhombus (A) outside the prescribed resection margin to make the inset of flap tension free and cur extra tissue at time of inset. Angle ABC of defect can be bisected at time of flap inset to make secondary flap S more mobile. (Figure 4)

In case of difficult to close defect make the flap a bit more acute and during the inset bisect the farthest angle of the defect for ease of inset. This technique may be more applicable over the scalp due to less mobility of scalp flaps (Case 2)

Conclusion:-

The Dufourmental flap can be very versatile and almost can be used in any area of the body with minimal donor site morbidity. In some specific cases, the inclusion of a known blood vessel can make the flap axial in pattern and allow for a larger flap. In the case of cosmetically sensitive areas like the face, it has the advantage of giving a better cosmetic outcome as the tissue for defect coverage is derived from multiple directions. The Dufourmental flap gives the surgeon more freedom to decide the angle of the rhombus and the angle of the apex of the flap which in some situations makes larger defects be closed by the local flap which otherwise would need a climb in reconstructive ladder. The various modifications of the flap increase the spectrum of application, and the results are gratifying as the design can be modified based on the area of the body as well as the experience and intuition of the plastic surgeon.

Conflict of interest statement:

The authors declare that they have no conflict of interest to the publication of this article.

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