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The anatomical basis of the SEPA flap

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Summary—The superficial external pudendal artery (SEPA) flap was described by Dias in 1984. This paper describes the anatomical foundation of the flap, based on dissections of 12 cadavers and clinical findings in patients undergoing surgery in the groin and lower abdomen.

The artery was found to be adequate in calibre and length to sustain a skin flap, on either side of the midline, extending from the symphysis pubis to the umbilicus.

There are three superficial branches of the femoral artery in the groin. They are the superficial circumflex iliac artery (SCIA), the superficial inferior epigastric artery (SIEA) and the superficial external pudendal artery (SEPA). All three vessels radiate out from the saphenous opening and give off branches which are mostly arranged in a radial fashion, like the spokes of a wheel, centred on the saphenous opening. Two of the three systems of the arteriovenous cartwheel of groin vessels (Smith *et al.*, 1972) have received attention and flaps based on them have been described, namely the hypogastric flap (Shaw and Payne, 1946) and the groin flap (McGregor and Jackson, 1972). As the SEPA had remained unexploited, the present study was undertaken to ascertain its potential.

Accurate knowledge of the anatomy of the vessel concerned is a prerequisite for designing an axial pattern flap. Unfortunately, textbooks of classical anatomy do not provide the kind of information which a plastic surgeon needs to plan a skin flap. In view of this, a detailed anatomical study of the SEPA was undertaken to know more about its origin and course, its anastomoses with the adjacent vessels and its termination. The diameter of the SEPA and its relation with the two layers of the superficial fascia were also noted.

Of the various methods employed to investigate the SEPA, dissections in formalin-fixed cadavers proved to be the most useful. Twelve dissections of the groin and hypogastrium were performed in which the course of the SEPA and its accompanying veins was explored between their origins and their terminal arborisation.

Method of dissection

Bilateral groin incisions were made 4 cm below and parallel to the inguinal ligament to expose the femoral vessels and the sapheno-femoral junction. The origin of the SEPA was demonstrated by fine dissection and its diameter was measured at this site. The termination of the superficial external pudendal vein was also dissected. For better definition, SEPA was then injected with a thick suspension of lead oxide in a mixture of turpentine and linseed oils. Lead oxide is bright red in colour and gives a good contrast, while turpentine and linseed oil facilitate the passage of the dye even into minute branches.

The vessels were then traced upwards, concentrating on the artery and its relation with the two layers of the superficial fascia. Its upward extent and anastomoses with the contralateral SEPA and the ipsilateral SIEA were also dissected. This dissection was facilitated by making two radiating incisions from the umbilicus to join the lateral ends of the groin incisions near the anterior superior iliac spine and cutting through Scarpa's fascia (membranous layer). This flap of infraumbilical skin was then turned down over the pubis. The plane of dissection was kept just deep to the vessels so that they were visible on the undersurface of the reflected flap.

Findings

In all 12 cadavers, the SEPA originated from the medial side of the femoral artery opposite the

sapheno-femoral junction (Fig. 1). At its origin, the SEPA usually did not exceed 2 mm in diameter and in only one cadaver was it larger (Fig. 2). It pierced the femoral sheath and the cribriform fascia and passed supero-medially towards the pubic tubercle. It crossed the femoral vein superficially at or above the sapheno-femoral junction, or passed in the angle between the great saphenous and the femoral vein with equal frequency. Before reaching the pubic tubercle it gave one or more descending anterior scrotal or labial branches and a variable number of small ascending branches. From a point just lateral to the pubic tubercle it then continued upwards towards the umbilicus.

Cross-anastomoses between the SEPAs of either side were constantly found in the distal half of their course (Fig. 3). There they rapidly divided into three to four longitudinally orientated terminal branches (Fig. 4). These branches continued their upward course, with further branching and anastomoses till they formed a subdermal plexus in the juxta-umbilical area. On the ipsilateral side, the SEPA anastomosed freely with branches of the SIEA (Fig. 5). From the average location of the artery, a central longitudinal axis could be drawn, from the pubic tubercle to the umbilicus at a point 1.5 cm away from the midline (Patil, 1983).

The depth of the vessel below the skin surface varied considerably depending on the adiposity of the cadaver. Therefore, rather than measure its depth in mm below the skin, it was decided to study its relation with the two separate layers of the superficial fascia as it was felt that this would be more useful to the surgeon when raising the flap.

Fig. 1

Figure 1—Cadaver dissection to show the origin of the right SEPA. The white arrow points to the sapheno-femoral junction.

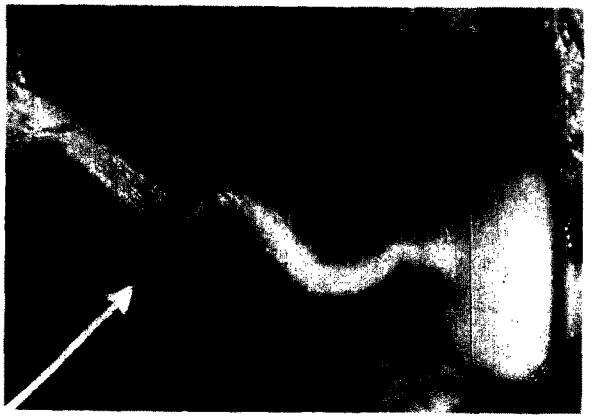

Fig. 2

Figure 2—Unusually large left SEPA (arrow).

The symphysio-umbilical distance was divided in four equal zones from below upwards and a transverse section was taken through the centre of each (Fig. 6) and the location of the artery in each zone was noted (Fig. 7). The artery was shown to become progressively more superficial as it passed from the pubic tubercle to the umbilicus. In this region of the body there seems to be greater provision for the venous drainage than for the arterial supply (Smith *et al.*, 1972). The superficial external pudendal vein was of greater diameter (Fig. 8) and the paired venae comitantes could also be seen in a well injected body (Fig. 9).

The SEPA system in patients undergoing surgery in the groin and lower abdominal area

After completion of the cadaver studies we turned our attention to observation of the circulation in the SEPA system under living conditions. Seven SEPAs were studied during the course of hernia repair and sapheno-femoral ligation. In every case the origin of the SEPA and its initial course was exposed and its diameter was measured. The findings corroborated the observations in our cadaver dissections except in one case where the origin of the SEPA was found high under the inguinal ligament. In another case of multiple burn contractures, in whom a large full thickness skin graft was removed from the lower abdomen, both SEPAs could be dissected and were found to extend up to the umbilicus where their diameter was 1 mm (Fig. 10).

Fig. 3

Figure 3—Distal portion of the flap showing the upward extent of both SEPAs and the distal cross-anastomoses between them (arrow). SIEA is also seen in the left half of the photograph. (Reproduced with permission of Aspen Publishers Inc. from Thatte and Patil in *Advances in Upper Extremity Surgery and Rehabilitation*, Ed. Boswick, J., 1986).

Fig. 4

Figure 4—Terminal branches of the SEPA are indicated by horizontal arrows. The vertical arrow points to a proximal cross-anastomosis between the two SEPAs and the white arrow at the top of the photograph indicates the site of the umbilicus.

Fig. 5

Figure 5—Anastomoses between the branches of the SEPA and SIEA.

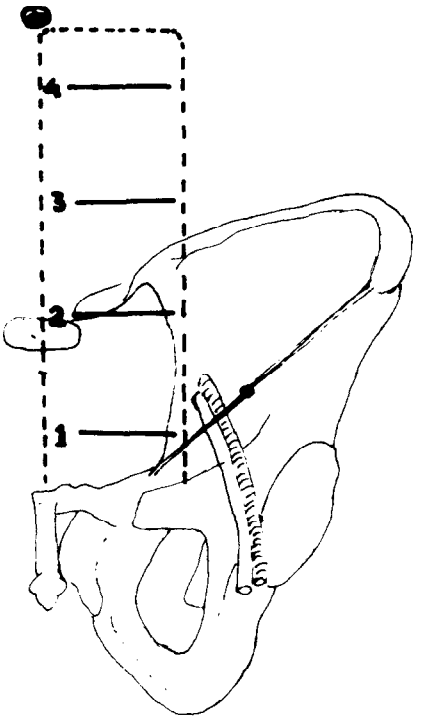

Fig. 6

Figure 6—Diagrammatic illustration to show the site of the transverse sections made in four zones to chart the anatomical depth of the SEPA.

Discussion

The vascular anatomy of a flap is usually studied in greater detail after it becomes a clinical success (Smith *et al.*, 1972; Freeman *et al.*, 1981; Cormack and Lamberty, 1983). When the vessel concerned has already been adequately described, it becomes easier to raise a flap based on that vessel. The situation was different in the case of the SEPA. Almost all books on anatomy make only a passing reference to this vessel, which is usually dismissed as being "small" or "insignificant". The initial course of the vessel as found in this study is in accordance with the following brief description given in Gray's Anatomy (1980):

> "The superficial external pudendal artery arises from the medial side of the femoral artery, close to the preceding vessels (SCIA and SIEA). Emerging from the femoral sheath and cribriform fascia, it goes medially, usually deep to the great saphenous vein, across the spermatic cord (or round ligament of the uterus), to the skin on the lower abdomen, the

Fig. 8

Figure 8—The superficial external pudendal vein is shown by black arrows. Its termination (white arrow) along with the terminations of SIEA and SCIA into the great saphenous vein is seen. SEPA is seen at a deeper level than the vein.

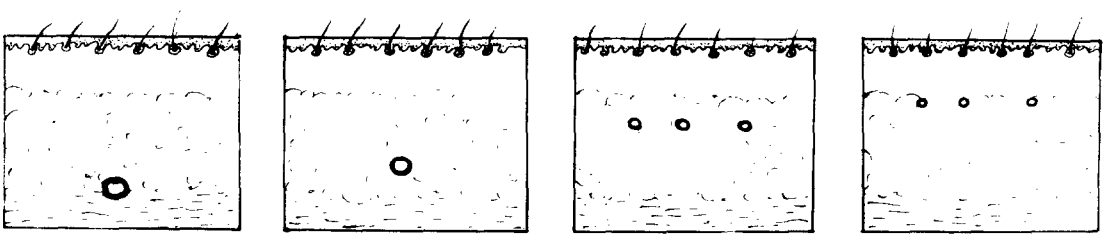

Fig. 7

Figure 7—Diagram to show that the location of the artery in each zone becomes progressively more superficial as the vessel is traced upwards and in Zones III and IV it has already arborised.

Fig. 9

Figure 9—Venae comitantes are seen on either side of the SEPA.

penis and scrotum or the labium majus, anastomosing with branches of the internal pudendal artery."

The above description does not mention the upward extent of the SEPA or its exact area of skin supply. It was therefore necessary to study its precise extent before a flap could be based on it. Prior cadaveric dissections helped us enormously and we would consider cadaveric studies to be an essential and invaluable preliminary step in clinical research of this nature. Accurate planning and design of the flap was possible along a central axis which had been determined by the cadaver studies. The planning of the flap has remained unchanged right from its inception and this is in contradistinction to the experience of Smith *et al.*, (1972) who, after studying the anatomy of the groin flap, subsequently designed it at a lower level than before. The pubic tubercle proved to be an important landmark. It indicates the point of entry of the artery into the flap, and therefore marks its base. It is also the pivot point around which the flap rotates for local use. Therefore, while planning the flap a "safety point" is marked 2 cm superolateral to the pubic tubercle to safeguard the artery as it enters the flap.

The ability to include both SEPAs in a combined bilateral flap has made the flap even more safe. The free anastomoses across the midline between the SEPAs of either side and between the SEPA and the ipsilateral SIEA are of considerable significance. The variations in the design of the flap (Dias *et al.*, 1987) and its combination with the hypogastric flap are based on these findings. As the artery becomes gradually more superficial in the flap from its base to its end, the flap can be cut thin in its distal half but needs to be elevated proximally on a slightly deeper plane. Although from 12 dissections it is not possible to draw statistically significant conclusions regarding variations in the SEPA system, the successful clinical application of the

Fig. 10

Figure 10—In a patient with multiple burn contractures, a large full thickness skin graft was removed from the lower abdomen, when both SEPAs could be dissected. On the left side it was reaching the umbilicus where its diameter was 1 mm.

SEPA flap in subsequent patients indicates a fair measure of constancy in the area of its supply and drainage, as originally noted during our anatomical study.

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This work won the Glaxo Award in 1984 for original research work in the field of plastic surgery. The award is given annually, to a plastic surgeon in training or within five years of his qualification, by the Medical Welfare Trust, Bombay.

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