

# Iliolumbar artery: a useful pedicle for the iliac crest free flap in maxillofacial reconstruction<sup>☆</sup>

T. Singh<sup>\*</sup>, K. Andi

*Department of Maxillofacial Surgery, St George's Hospital, Blackshaw Rd, SW17 0QT, London, United Kingdom*

Accepted 23 December 2016

Available online 11 January 2017

## Abstract

The iliac crest free flap is commonly used in maxillofacial reconstruction, and is typically supplied by the deep circumflex iliac artery (DCIA). However, the iliolumbar artery is an alternative blood supply that can potentially be used in such reconstructions. We describe the anatomy of the iliolumbar artery and review publications about its clinical use. We raised four cadaveric iliac crest free flaps using both the DCIA and the iliolumbar artery to illustrate its use in reconstructing maxillofacial defects. It provided a longer pedicle for microvascular anastomosis than the DCIA, was more versatile in orientation of the flap, and allowed the chance of anastomosing both pedicles to “super-charge” the flap’s blood supply. We describe a patient in whom this flap was used successfully, which shows that the iliolumbar artery is a suitable pedicle to augment (or replace) the DCIA in an iliac crest free flap.

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*Keywords:* Microvascular; Reconstruction; Composite Flap

## Introduction

Since the development of microvascular surgery with free flaps, excellent functional and aesthetic results have been obtained after resection of maxillofacial tumours. Despite a wide range of reconstructive options being available, it is still not clear which flap is the most suitable for certain defects.<sup>1</sup> Two commonly used flaps for osseous maxillofacial reconstruction are the fibular free flap and the iliac crest free flap. The latter is normally pedicled off the deep circumflex artery (DCIA), but the iliolumbar artery is a possible alternative.

Since being reported by Winters et al in 1996,<sup>2</sup> the iliac crest free flap supplied by the iliolumbar artery rarely been described in reports of maxillofacial and reconstructive

surgery. Here we explain how the iliac crest free flap can be augmented by using either the iliolumbar or the DCIA pedicle, or both, which permits a potentially longer pedicle for microvascular anastomoses, more versatility in orientation of the flap, and gives the opportunity to anastomose both pedicles to “super-charge” the flap’s blood supply.

The fibular free flap is usually used when osseous or composite maxillofacial reconstruction is required. It offers relatively easy dissection of the flap, a long piece of bone, and a skin paddle with predictable perforators. However, the lack of bony height can sometimes make dental rehabilitation with implants challenging without further augmentation. The donor site of the skin paddle can be closed primarily, but often requires a skin graft to cover it. Nevertheless recent meta-analyses showed that the overall morbidity at the donor site for the femoral and iliac crest free flaps was similar.<sup>3,4</sup>

The iliac crest free flap is usually based on a pedicle formed by the deep circumflex iliac artery (DCIA) and vein. When compared with the fibular free flap, the iliac crest free

<sup>☆</sup> This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

<sup>\*</sup> Corresponding author. Tel.: +44 7949043268.

E-mail addresses: [thasvir.singh@nhs.net](mailto:thasvir.singh@nhs.net) (T. Singh), [kavin.andi@stgeorges.nhs.uk](mailto:kavin.andi@stgeorges.nhs.uk) (K. Andi).

flap provides improved bony height and width, and if necessary, a large bulky piece of muscle in the form of the internal oblique muscle pedicled from the ascending branch of the DCIA. In 1979 it was described as a possible free flap by Taylor et al,<sup>5</sup> with the incorporation of a skin paddle in the same year by Sanders and Mayou,<sup>6</sup> followed by its use in mandibular reconstruction by Urken et al<sup>7</sup> The iliac crest free flap requires technically more difficult dissection than the fibular free flap (particularly in obese patients), and when a skin paddle is incorporated it is said to be immobile and more unreliable. It also has a relatively short pedicle, which can be a particular problem when used for reconstruction of the midface.<sup>1,8</sup>

### Vascular anatomy

The iliac crest is supplied by multiple vessels including the DCIA, iliolumbar artery, fourth lumbar artery, and superior gluteal artery.<sup>9,10</sup>

#### DCIA

The mean (SD) length of the DCIA is 6.2 (0.7) cm from the anterior superior iliac spine and it has a diameter of 2.6 (0.4) mm.<sup>11,12</sup> It should be noted that the pedicle can be lengthened by taking a more posterior segment of the iliac crest, particularly if a segment 2–3 cm from the anterior superior iliac spine is left intact and not taken with the flap. The DCIA gives off 1–4 muscular branches to the abdominal musculature including the ascending branch, which perforates the transverse abdominis muscle to go along the underside of the internal oblique muscle, which it supplies.<sup>13</sup>

After it has passed the anterior superior iliac spine, the DCIA travels between iliacus and transversalis fascia close to the iliac crest (up to 2 cm below its superior edge) where it provides branches to nourish the inner bony cortex. Where it ends is controversial, as some authors have described a terminal musculocutaneous perforator approximately 6 cm posterior and 1.5 cm lateral to the anterior superior iliac spine.<sup>13</sup> However, Chen et al<sup>14</sup> and Taylor et al<sup>5</sup> showed that it anastomoses with the iliolumbar artery before terminating separately (Fig. 1).

#### Iliolumbar artery

The iliolumbar artery and its branches have been successfully used as both pedicled and microvascular free flaps for orthopaedic and spinal surgery.<sup>10,13,15</sup> Both cadaveric and clinical studies have shown that it supplies a distribution area of the iliac crest of about 7.0 (2.2) cm, with the artery having a reliable anatomical course without appreciable ethnic differences.<sup>9,14,16</sup> It usually originates from the internal iliac artery (96%), and less often from the common iliac artery or the posterior trunk of the internal iliac artery.<sup>9,14,16</sup> Thereafter it passes between the obturator nerve, lumbosacral plexus,

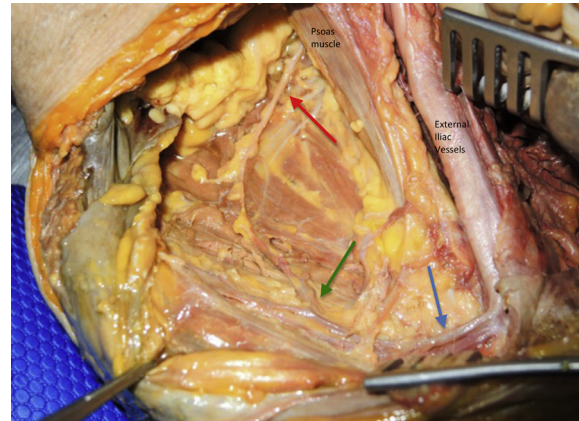


Fig. 1. Anastomosis (green arrow) of deep circumflex iliac pedicle (blue arrow) to the iliolumbar pedicle (red arrow). The iliolumbar vessels emerge lateral to the psoas muscle.

and external iliac vessels before running under the psoas major muscle and emerging from its lateral edge (Fig. 1).<sup>9,10</sup> In most cases the artery runs between the iliac fascia and iliacus muscle to supply both the iliac crest bone (iliac branch) and the iliacus (muscular branch),<sup>1,10</sup> thereafter anastomosing with both the DCIA and the fourth lumbar artery.<sup>14,16</sup> It is likely that the internal oblique muscle also has a vascular supply from the iliolumbar artery, which allows it to perfuse adequately if the iliolumbar artery, or the DCIA, or both are used for microvascular anastomosis.<sup>2</sup> It should be noted that anatomical variation has been described where the dominant nutrient pedicle to the middle aspect of the iliac crest was the fourth lumbar artery.<sup>14</sup> However, this has not been documented elsewhere.

At the lateral edge of the psoas muscle (clinically the most proximal site of possible ligation of the iliolumbar artery during harvest of an iliac crest flap) the iliolumbar artery is a 7.0 (3.9) cm long with a diameter of 2.0 (0.4) mm,<sup>1,14</sup> which is predictably narrower than at its origin with the iliac artery where it is 3.7 (0.7) mm. The iliolumbar artery travels with a single vena comitans, however there are venae comitantes in 32.6% of cases, which join together at the lateral edge of the psoas muscle. They drain into a variable venous system including the internal, external, common iliac, and ascending lumbar veins.<sup>14</sup>

### Clinical applications

Winters et al showed that the iliolumbar artery can be used successfully as a pedicle for reconstruction with an iliac crest flap in spinal surgery.<sup>10,13,15</sup> However, only a few papers have described its use in maxillofacial free flap reconstruction. Winters et al described a case where it was used to supplement (“super-charging”) the DCIA in the harvest of a large (14 cm) DCIA composite osseomyocutaneous flap.<sup>1</sup> Chen et al<sup>14</sup> used it in two free flaps, and Liu et al<sup>17</sup> used both the DCIA and the iliolumbar artery for a large mandibular recon-

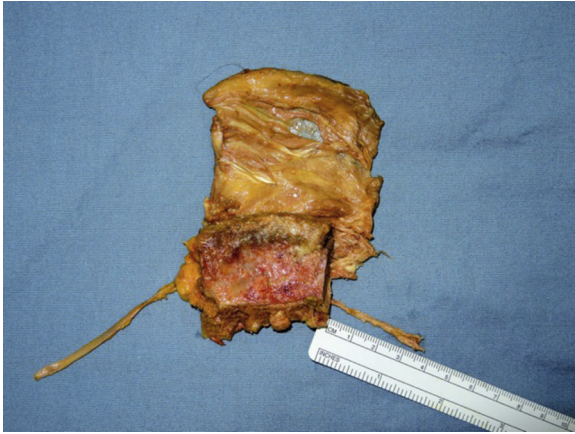


Fig. 2. Iliac crest free flap raised with the internal oblique muscle. The pedicle of the deep circumflex artery is considerably shorter than the iliolumbar pedicle.

struction. Sasaki et al<sup>18</sup> also showed that the DCIA is not always predictable, and successfully used an iliac crest flap based on the iliolumbar artery because the DCIA was missing. Our search of publications showed no other papers in which the iliolumbar artery had been used as the sole pedicle for a iliac crest flap in maxillofacial reconstruction but, given its success in spinal surgery, it can be deduced that it is a viable option in the head and neck as well.

We dissected four iliac crest free flaps in two cadavers to evaluate the possibility of an iliac crest free flap supplied by the iliolumbar artery, with or without the DCIA. After we had identified the DCIA and dissected the pedicle posteriorly, the iliolumbar artery was relatively easy to find using the anatomical pathway of the vessels described earlier. A 5 cm segment of iliac crest was harvested, and we preserved about 2 cm of crestal bone adjacent to the anterior superior iliac spine. The mean (range) length of the DCIA pedicle was 4.1(3.9 – 4.3) cm, and that of the iliolumbar arterial pedicle was 6.2 (5.5 – 6.5) cm (Fig. 2). The harvested flaps were inset to reconstruct maxillectomy and mandibulectomy defects. Fig. 3 shows the iliac crest free flap set into a left mandibulectomy defect, where the iliolumbar artery has a longer pedicle than the DCIA. In Fig. 4 the iliac crest free flap is inset into a right-sided Class 2b maxillectomy defect (Brown et al).<sup>19</sup> The increased length of the pedicle of the iliolumbar artery is particularly useful in the reconstruction of midface defects where access to cervicofacial donor vessels for microvascular reconstruction can be difficult. Both figures clearly illustrate the natural contour of the DCIA in reconstructing maxillofacial defects, while also providing an excellent source of bone for oral rehabilitation.

### Case report

A 65-year-old man presented to the Maxillofacial Surgery Department at St George's Hospital in 2015 with a T4N2cM0

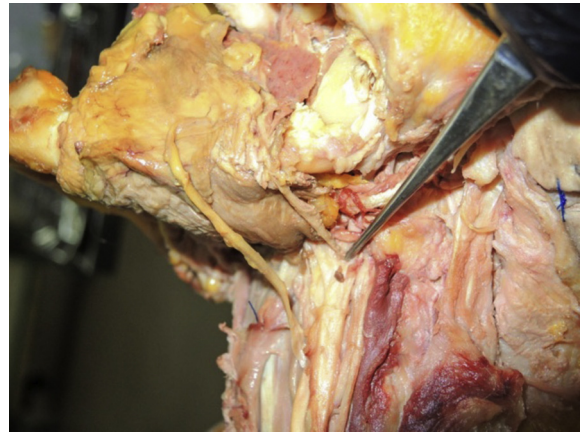


Fig. 3. Iliac crest free flap to reconstruct a left-sided segmental mandibulectomy defect. Pedicles of both the iliolumbar and deep circumflex iliac arteries can be used for microvascular anastomosis if required.



Fig. 4. Iliac crest free flap used to reconstruct a right-sided Class 2A maxillectomy defect. The length of the pedicle of the iliolumbar vessels can help to reach the cervicofacial vessels for anastomosis.

squamous cell carcinoma of the left mandibular alveolus. He was treated by left segmental mandibulectomy, left modified radical neck dissection, right selective neck dissection, and reconstruction with a left iliac crest free flap. The flap was harvested in the standard manner by identification of the ascending branch of the DCIA after the internal oblique muscle had been raised. However, when we traced the DCIA pedicle out to the external iliac vessels the pedicle was both short and small. We marked out a 5.5 cm section of the iliac crest 2 cm posterior to the anterior superior iliac spine, and osteotomised it, preserving a cuff of iliacus muscle. Before we ligated the pedicle we traced it posteriorly to where the more substantial iliolumbar artery pedicle was, and dissected it free from the surrounding tissues. The iliolumbar pedicle was ligated at the lateral border of the psoas muscle, and then the flap was raised before the DCIA pedicle was ligated at its junction with the external iliac vessels. With



microvascular surgery we used both pedicles. The iliolumbar artery was anastomosed to the facial artery, the DCIV to the stump of the internal jugular vein, and the iliolumbar vein to the external jugular vein for additional venous drainage. The patient made an uneventful recovery and was discharged from hospital 12 days later.

This case illustrates the versatility of having two pedicles for the iliac crest free flap as more options were available for its orientation and microvascular anastomosis. More importantly, the DCIA pedicle was short, but a vein graft was avoided by using the iliolumbar artery.

## Conclusion

The iliolumbar artery is a suitable pedicle to augment (or replace) the DCIA and supply an iliac crest free flap. The vessels have sufficient length and diameter, and are easy to identify and dissect in the loose connective tissue that overlies the iliac muscle. Its predictable anatomy makes the iliolumbar artery a useful addition to the reconstructive surgeon's armamentarium. Although it is not well described, we have illustrated how the iliolumbar artery can be used successfully for complex maxillofacial reconstruction.

## Conflict of interest

We have no conflicts of interest.

## Ethics statement/confirmation of patient's permission

Not required.

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