# Practical Aspects of Hair Transplantation in Asians

Damkerng Pathomvanich Kenichiro Imagawa *Editors* 

*With contributions by* Robert Haber



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ISBN 978-4-431-56545-1 ISBN 978-4-431-56547-5 (eBook) https://doi.org/10.1007/978-4-431-56547-5

Library of Congress Control Number: 2017964006

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Printed on acid-free paper

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The registered company address is: Shiroyama Trust Tower, 4-3-1 Toranomon, Minato-ku, Tokyo 105-6005, Japan

### Foreword

Do we really need another hair transplant textbook? I think that question is part of the Foreword of quite a few textbooks. And why one that focuses on Asians? Couldn't that just be a chapter in one of the "standard" textbooks? The answers to those questions will be evident within the pages of this text. Few surgical procedures see so many advances on a regular basis. By the time a textbook is published, advances will have made some chapters obsolete, and technique refinements will have changed recommendations found in others. And while some surgeons are content to perform the same technique and see the same results year after year, the really great ones are constantly striving toward the unreachable goal of perfection, and in that pursuit eagerly absorb the contents of the latest articles and textbooks.

I am a "lumper" and not a "splitter," meaning that I do not like to subdivide categories, unless there is a significant benefit to doing so. Thus, I like the simple categories of "Caucasian" and "Asian" and "African." But as a Caucasian myself, I was ignorant of the remarkable breadth of what constitutes "Asian." Only after accepting Damkerng's offer to assist with the editing of this text, and educating myself regarding what it means to be Asian, did I truly understand that only a comprehensive Asian textbook can adequately address the myriad phenotypic, ethnic, and societal aspects of hair transplantation in this diverse category.

This text does not limit itself to the unique hairline design approaches required for brachycephalic skulls, as that would indeed only require a chapter in another text. Rather, this is a comprehensive text including all aspects of hair restoration, from general recommendations and scalp diseases, to strip and FUE donor harvesting, hairline design and implantation techniques, to complications. Staff training approaches are reviewed, as well as adjunctive pharmacologic treatments and nonpharmacologic interventions such as PRP, SMP, and light therapy. In addition, highly advanced techniques such as eyebrow, eyelash, pubic hair, beard, and transgender transplantation techniques are discussed. While I edited, I also learned. Because of language barriers, many of these authors will not be seen at the podium of the ISHRS World Congress, and that is a shame, as clearly the quality of work performed in the included Asian regions is excellent. I feel very fortunate to be one of the first people to actually read this text cover to cover, as I have had the advance opportunity to try some of the many ideas and techniques in my office. And while the task of converting these manuscripts into grammatically correct English was at times arduous, I cannot imagine writing a scientific chapter in a language other than my own, so my profound respect goes to the authors from so many countries who did just that. It was both a pleasure and an honor to work with Damkerng Pathomvanich and Kenichiro Imagawa, two individuals who have successfully bridged the East and the West, and who I am fortunate to call friends, and not just colleagues.

Beachwood, OH, USA

Robert Haber

# Preface

Since the publication of our first Asian textbook entitled *Hair Transplantation in Asians* in 2010, we have come to realize that the scope of the textbook did not cover the entire Asian continent (please see Chap. 1, "The Asian Continent: Its Origin and Evolution," for details). We realize that even among Asians countries, differences in culture, skin texture, and skin color greatly contribute to the success of the procedure and, ultimately, to the patient's utmost satisfaction. Hence, the concept of a second edition that encompasses the challenges of hair transplantation in different Asian ethnicities is introduced.

The contents of this new book include the majority of Asian countries where hair transplantation is actively performed with optimal results. Luckily, Asians have only black hair which makes it a bit easier for hair transplant surgeons to deal with in comparison to Caucasians with different color shades.

It was a very arduous task to gather and select prominent physicians from East, Southeast, South, and West Asian regions with extensive experience in hair transplantation for over a decade, to write and give the reader an insight into different hairline designs among Asians and to enlighten us as to the differences in hair transplantation in Asia compared to Europe and North America in terms of techniques and the like. This practical book also caters to all types of readers, be it an entrepreneur, a new doctor yearning to gain experience in hair transplantation, an experienced hair surgeon, or anybody interested in this field. This book will prove to be a valuable tool.

The number of hair transplantation procedures in Asian countries has continued to increase and has actually surpassed the United States of America and Europe, based on the 2015 data from the ISHRS. After one and a half decades, the number of FUE procedures performed in treating male pattern hair loss almost equaled FUT for the first time. It was predicted that FUE might outperform FUT in the future but this remains to be seen. PRP and LLLT which continue to proliferate as alternative treatments for hair loss are included in this textbook. Hair cloning is now trending in popularity and might be available in the United Kingdom soon to treat thinning hair, but it will take a few more years to see the effectiveness of this treatment. Innovations in new FUE machines and punches to improve and minimize transection

of the follicles are emerging each year. Hopefully in the future, we might have a device that allows the surgeon to see the mysterious direction of the hair follicle beneath the scalp, which, for now, we blindly try to harvest.

Editing this text was challenging since English is not the primary language in Asia. I'm very fortunate and excited that Dr. Robert Haber, a good old friend who completed his fellowship training at the Stough Clinic (as I did), accepted the role of an associate editor. I would like to thank Bob Haber who has been working tirelessly the whole year editing and providing grammar checks in the manuscripts. I have learned that he also has another book to edit, must prepare lectures for various meetings, and runs a busy private practice and takes care of his beloved father. Without the assistance of Dr. Dell Kristie A. Ortega-Castillejos, my fellow from the Philippines, and Dr. Sittichai Ingprasert, my fellow from Thailand, I would be dead. They have organized all the chapters, contacted the authors, and checked the manuscript format before sending to Bob Haber for editing. Thank you Drs. Dell and Sittichai. My thanks also goes to Ms. Natenapa Arunrattanapong, my nurse, who helped me select the best pictures for my text. I would also like to extend my heartfelt gratitude to all contributing authors for putting their valuable time and knowledge toward writing for this book. Lastly, I would like to thank my loving family for their patience in coping with me and for the stolen family time for the past 2 years.

There are many new textbooks in hair transplantation. However, this text focuses only on *the practical aspects of hair transplantation in Asians*. The tips and pearls provided in the boxes in each chapter will give the reader easy access to valuable information for their practice. I sincerely hope this textbook will be a good asset to all of us who practice hair restoration surgery.

Phayathai, Bangkok Thailand Damkerng Pathomvanich, M.D., F.A.C.S., F.I.S.H.R.S.

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# Part I Anatomy and Biology

# **Chapter 1 The Asian Continent: Its Origin and Evolution**



Dell Kristie A. Ortega-Castillejos

#### 1.1 Asia's Geography

The history of Asia can be seen as the collective history of coastal regions such as East Asia, South Asia and Middle East linked by the interior mass of the Eurasian steppe [1]. Asia is the earth's largest and most populous continent, located primarily in the Eastern and Northern Hemispheres [3]. It comprises 30% of the earth's land area and has the bulk of the planet's human population, currently roughly at 60% [2]. It is bounded on the east by the Pacific Ocean, on the south by the Indian Ocean, and on the north by the Arctic Ocean (Fig. 1.1). It is subdivided into 48 countries, two of them (Russia and Turkey) having part of their land in Europe [2] (Fig. 1.2).

Asia has a mix of different climates, ranging from the equatorial south via the hot desert of the Middle East, temperate areas in the East, and the extremely cold weather in polar areas of Siberia [2]. This has led to adaptation of its inhabitants to its environment, hence the racial diversity in the looks and build of each ethnic group in Asian countries (Fig 1.3).

Such ethnic groups are mainly subdivided into North Asians, South Asians, East Asians, Southeast Asians, and West Asians. For purposes of discussion with regard to hair transplantation, we have excluded North Asians in this book, as we rarely get patients from these countries.

East Asia, in general terms, consists of China, Hong Kong, Macao, Taiwan, Japan, South Korea, and North Korea. (Table 1.1) The dominant influence histori-

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D. Pathomvanich, K. Imagawa (eds.), *Practical Aspects of Hair Transplantation in Asians*, https://doi.org/10.1007/978-4-431-56547-5\_1



Fig. 1.1 Ocean boundaries of Asia (Reproduced from www.mapsofworld.com)

cally has been China, but in modern times, cultural exchange has flowed bidirectionally [2] (Fig. 1.2).

South Asia mainly consists of the countries of Bangladesh, Bhutan, India, Maldives, Nepal, Afghanistan, and Sri Lanka [2] (Fig. 1.2) (Table 1.1).

Southeast Asia is often split into two parts: Mainland Southeast Asia, comprising Burma, Cambodia, Laos, Peninsular Malaysia, Thailand, and Vietnam. The other part is Maritime Southeast Asia which includes Brunei, East Timor, Indonesia, East Malaysia, the Philippines, and Singapore [2] (Fig. 1.2) (Table 1.1).

Southeast Asia has had a lot of Western influence due to the lasting legacy of colonialism. One example is the Philippines, which has been heavily influenced by Spain and the United States over the course of almost four centuries of colonization [2].

West Asia largely corresponds with the term Middle East [2]. It consists of Armenia, Azerbaijan, Bahrain, Cyprus, Iran, Iraq, Israel, Georgia, Jordan, Kuwait,



Fig. 1.2 Asian countries (Reproduced from Geography of Asia. http://en.wikipedia.org/wiki/Geography\_of\_Asia)



**Fig. 1.3** Racial diversity among Asian people (Reproduced from Mongoloid. https://en.wikipedia. org/wiki/mongoloid)

East Asia	China, Hong Kong, Macao, Taiwan, Japan, South Korea, and North Korea
Southeast	Burma, Cambodia, Laos, Malaysia, Thailand and Vietnam, Brunei, East Timor,
Asia	Indonesia, the Philippines, and Singapore
West Asia	Armenia, Azerbaijan, Bahrain, Cyprus, Iran, Iraq, Israel, Georgia, Jordan,
	Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab
	Emirates, and Yemen
South Asia	Bangladesh, Bhutan, India, Maldives, Nepal, Afghanistan, and Sri Lanka

 Table 1.1
 Asian countries according to geographical subdivision

Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen [2] (Fig. 1.2) (Table 1.1).

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# Chapter 2 Practical Anatomy in Hair Transplantation



#### Sittichai Ingprasert, Patra Pinyopawasutthi, and Damkerng Pathomvanich

#### 2.1 Introduction

The authors have selected and illustrated specific anatomical features of the scalp that are essential for the surgeon when performing hair restoration surgery and not general scalp anatomy as described elsewhere.

#### 2.2 Embryology

Hair follicles are derived from an interaction between embryological ectoderm and mesoderm. The full development of the hair follicle is the result of a complex sequence of signals both within and between the epidermis and dermis. The hair follicle development is differentiated into four stages: placode, germ, peg and bulbous peg, and between the 10th week and 18th week of intrauterine life [1].

#### 2.3 Anatomy of Hair Follicle

The hair follicles consist of the infundibulum, isthmus, and bulb. The dividing line between two parts is just below the bulge or the insertion of the arrector pili muscle [2] (Fig. 2.1).

The outer root sheath is the site of follicular stem cells, and most stem cells are in the bulge and along the isthmus located 1.0 mm from skin surface [3]. Therefore,

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D. Pathomvanich, K. Imagawa (eds.), *Practical Aspects of Hair Transplantation in Asians*, https://doi.org/10.1007/978-4-431-56547-5\_2



Fig. 2.1 Anatomy of hair follicle in longitudinal section (a) and cross section (b)

transections less than 1.0 mm in depth, including trichophytic closure, will not affect hair growth.

The arrector pili muscle attaches to the hair bulge and may have some interaction with the stem cells. Recent findings demonstrate an association between the loss of arrector pili muscle attachment and miniaturization in androgenetic alopecia (AGA) [4]. In AGA, the arrector pili muscle gradually degenerates and is replaced by adipose tissue, while this change has not been noticed in other reversible hair loss problems such as telogen effluvium or alopecia areata [5]. Hair shaft thickness can be classified as vellus, intermediate, and terminal hairs (Fig. 2.2):

*Vellus hair* is fine and poorly pigmented. The depth of the vellus hair root is  $0.646\pm0.140$  mm [6], and the thickness of hair shaft is less than 30 µm.

*Intermediate hair* is less pigmented than the terminal hair and is a transition of vellus to terminal hair. The length below the skin surface is 2.59±0.07 mm [7].

*Terminal hair* has a longer length and a larger diameter compared to other hair fibers. It is a thick and pigmented hair that has fully matured, with a hair diameter of more than  $60 \ \mu\text{m}$ .

Asian hair has different characteristics from Caucasians (Fig. 2.3). The average depth of the hair root in Asians is 4.0–5.0 mm [8] (Fig. 2.4) which is deeper than in Caucasians (3.8–4.6 mm) [3]. Hair shaft thickness in East Asians is 100  $\mu$ m, compared with 70  $\mu$ m for Caucasians [9]. There is a positive correlation between the hair shaft diameter and hair root depth [10]. Hence, harvesting with FUE in Asians has higher transection rates and more vascular injury. Hair exit angle at the scalp varies from site to site. The exit angle becomes more acute at the neck and temple regions and more obtuse toward the crown or top area. Furthermore, the hair



**Fig. 2.2** Follicular unit (FU) consisting of terminal hair in 1-hair, 2-hair, and 3-hair FU (*upper row*) and miniaturized hair with terminal hair (*lower row*)



**Fig. 2.3** The comparison of follicular unit between Asian (*left*) and Caucasian (*right*) with the same magnification at the external occipital protuberance (see text in detail)

**Fig. 2.4** Depth of Asian hair follicle and variation in length



alignment underneath the skin can be altered. The change between internal and external angle has been studied and showed that the average angle change was  $6.43^{\circ}$  and  $14.65^{\circ}$  in straight and curly hair, respectively [11]. Therefore, the FUE surgeon should consider changing the hand movement according to the depth or use a larger punch size to reduce the transection rate.

#### 2.4 Anatomy

#### 2.4.1 Head Shape

The head shape proportion differs from race to race. The Asian skull is brachycephalic with a rounder skull in comparison with dolichocephalic or longer skull in Caucasians (Fig. 2.5) [12].



Fig. 2.5 Skull comparison between Asian (*left*) and Caucasian (*right*)

#### 2.4.2 Scalp Layers

The scalp consists of five layers and extends from the top of the forehead to the superior nuchal line. The first three layers are bound together and easily separate from the other two [13]. The acronym "SCALP" denotes these five layers (Fig. 2.6):

Skin. The thick skin of the scalp is hairy and rich in sebaceous glands.

Connective tissue. It contains numerous blood vessels, nerves, and fibrofatty tissue. Dissecting in this plane will encounter profound bleeding from the anastomoses between branches of the occipital, superficial temporal, and supraorbital vessels.

Aponeurosis. Epicranial aponeurosis is a thin, tough, fibrous sheet connected to occipitofrontalis muscle and temporal fascia.

Loose areolar tissue is the subaponeurotic space and loosely attaches the aponeurosis and pericranium. This layer is avascular and excellent for dissecting in flap surgery.

Pericranium is the periosteum of skull.

#### 2.4.3 Vascular Supply of the Scalp

Supratrochlear and supraorbital arteries are branches of ophthalmic arteries (internal carotid arteries), which arise from the medial part of superior orbital rim and ascend to supply the frontal scalp. The superficial temporal artery, a branch of



**Fig. 2.6** Dissection plane of strip harvesting above the aponeurosis but below hair bulbs (**a**). Illustration shows scalp layers with vascular supply (**b**). Scalp layers at temporal area (2.7c)



Fig. 2.6 continued

external carotid artery, gives anterior and posterior branches to supply the scalp over the frontal and temple regions. Posterior auricular arteries ascend behind the ears and supply the skin above the auricles. Occipital arteries, which are branches of the external carotid artery, emerge to the scalp by passing between the trapezius and sternocleidomastoid near their occipital attachment and supply the posterior part of the scalp. All of these arteries freely anastomose with one another. The veins of the scalp accompany the arteries and have similar names (Fig. 2.7).

Vascular injury can occur during strip harvesting or scalp flap surgery, especially the occipital vessels which ascend beneath the fascia overlying the occipitalis muscle (Fig. 2.8). The distance between occipital arteries ranges from 10–11.5 cm [14]. Occasionally, superficial temporal arteries are encountered if the donor harvesting is performed beyond the ears (Fig. 2.9).

#### 2.4.4 Sensory Nerve Supply of the Scalp

Innervation on the donor area is mostly contributed by the greater occipital, lesser occipital, and auriculotemporal nerves (Fig. 2.10). The greater occipital nerve is accompanied by the occipital artery. The lesser occipital nerve ascends along the



Fig. 2.7 Vascular supply of the scalp

**Fig. 2.8** Superficial temporal vessel (*white arrow*) and occipital vessel (*black arrow*)





**Fig. 2.9** Superficial temporal vessel when strip harvesting above the auricle



Fig. 2.10 Sensory nerve supply of the scalp

posterior margin of sternocleidomastoid and passes up on to the scalp behind the ear, while the auriculotemporal nerve emerges behind the temporomandibular joint and ascends to supply temple area.

Supratrochlear and supraorbital nerves are the small and large terminal branches of the frontal nerve. The supraorbital nerve transverses from supraorbital foramen located on the medial 1/3 of supraorbital rim and gives off medial and lateral branches that supply the skin of the forehead to the vertex. The medial branch perforates the frontalis muscle, while the lateral branch ascends further and pierces the epicranium. The supratrochlear nerve emerges between the trochlea and supraorbital foramen to supply the skin of the lower forehead near the midline. The frontotemporal area and temple points are supplied by zygomaticotemporal and auriculotemporal nerves.

#### 2.4.5 Lymphatic Drainage of the Scalp

Lymphatic drainage from the forehead, temporal region, and sideburns go to the superficial parotid nodes, which lie just anterior to the tragus. The scalp above and behind the ear drains to the upper deep cervical and posterior auricular nodes which are located on the mastoid process. The occipital part of the scalp drains to the occipital nodes and lower deep cervical nodes. Occipital nodes are commonly superficial to the upper attachment of the trapezius muscle (Fig. 2.11). Enlargement of lymph nodes leads to the area of lymphatic drainage as described.



Fig. 2.11 Lymphatic drainage of the scalp

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# Chapter 3 Hair Characteristics of East and Southeast Asians



**Dell Kristie Ortega-Castillejos** 

#### 3.1 Introduction

Most Asian hairs are black in color, coarse, and straight [1]. This stark contrast with the light color of the scalp makes hair transplantation a tad more difficult in the sense that the color differences of the scalp and hair is a factor in creating acceptable densities for each patient. However, the thick-caliber hair shafts of Asian hairs compensate for this disadvantage, as it requires very small graft numbers to produce a natural look [1].

Caucasians are reported to have more density compared to Asians [1, 2]. Avram et al. noted that the average follicular unit density in the donor area of Caucasians ranges from 70–100 FU/cm<sup>2</sup> with the average hair density count of 260 ( $\pm$ ) 30 hairs/cm<sup>2</sup> [3].

East and Southeast Asian hairs do not differ much in terms of color, caliber, curl, and densities. However, there are certain specific qualities of each ethnicity that separates East from Southeast Asians. East Asia is comprised primarily of China, Hong Kong, Taiwan, Japan, and South and North Korea, while Southeast Asia is comprised of Burma, Cambodia, Laos, Malaysia, Thailand, Vietnam, Brunei, East Timor, Indonesia, the Philippines, and Singapore (refer to Chap. 1).

In a study done by Tsai et al., the normal Chinese scalp was found to have an average density of 71.78 FU/cm<sup>2</sup>, translating to 137.08 hairs/cm<sup>2</sup>, with a predominance of 2-hair follicular units at 50.29% [4]. This study also concluded that Chinese men with androgenetic alopecia have an average of 68.07 FU/cm<sup>2</sup> [4]. Kim likewise noted in a different unit of measurement that Korean scalps have an approximate density of 120 hairs/cm<sup>2</sup> in the occipital zone and about 100 hairs/cm<sup>2</sup>

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D. Pathomvanich, K. Imagawa (eds.), *Practical Aspects of Hair Transplantation in Asians*, https://doi.org/10.1007/978-4-431-56547-5\_3

in the temporal area [1]. He also stated that Korean subjects were noted to have the following proportion of follicular groupings: 45% of 1-hair FU, 42% of 2-hair FU, and 7% of 3-hair FU [1].

In a retrospective assessment done by Ortega-Castillejos and Pathomvanich, East and Southeast Asian men with androgenetic alopecia had an average density of 61.1 FU/cm<sup>2</sup> with 111.2 hairs/cm<sup>2</sup> [5] (Table 3.3) (Fig. 3.1). The study also noted the following proportion of follicular unit grafts in different points of the scalp: 57.5 FU/cm<sup>2</sup> for the left temporal area, 61.6 FU/cm<sup>2</sup> for the left parietal area, 65.6 FU/cm<sup>2</sup> for the central occipital area, 63.6 FU/cm<sup>2</sup> for the right parietal area, and 57.2 FU/cm<sup>2</sup> for the right temporal area [5] (Table 3.1).

It is also interesting to note that East and Southeast Asians have a predominance of 2-hair FU grafts at 54.2%, which is found to be densest at the central occipital region [5]. The proportion of each follicular unit in different points of the scalp is further outlined on Table 3.2.

Having determined the average number of FUs/cm<sup>2</sup>, the authors in the similar study have also determined the average number of hairs in different points of the scalp (Table 3.3).

Fig. 3.1 Southeast Asian Hair



Table 3.1	Follicular	unit	density	for	each	reference	point	in	East	and	Southeast	Asians
-----------	------------	------	---------	-----	------	-----------	-------	----	------	-----	-----------	--------

Left		Central	Right	Right	Average
temporal	Left parietal	occipital	parietal	temporal	density
57.5 FU/cm <sup>2</sup>	61.6 FU/cm <sup>2</sup>	65.6 FU/cm <sup>2</sup>	63.6 FU/cm <sup>2</sup>	57.2 FU/cm <sup>2</sup>	61.1 FU/cm <sup>2</sup>

Excerpts from Retrospective Assessment of Follicular Unit Density in Asian Men with Androgenetic Alopecia. Ortega-Castillejos, MD, Pathomvanich MD. Dermatol Surg 2017; 43(5): Table 1, pp. 675

While the density of the donor area is an important factor in hair restoration, the degree of miniaturized hair is also of utmost concern in predicting the success of this procedure [6, 7]. Ortega-Castillejos and Pathomvanich have studied this aspect in East and Southeast Asians and have concluded that the average number of miniaturized hairs in this ethnicity is 7.8 hairs/cm<sup>2</sup>, which is 7% of the total amount of hairs/cm<sup>2</sup> [5]. Table 3.4 will show that the temporal areas have the largest amount of miniaturized hairs and thus depict that this reference point is the most unstable area for harvesting in East and Southeast Asians (Table 3.4).

Reference Pt.	1-hair/cm <sup>2</sup>	2-hair FU/cm <sup>2</sup>	3-hair FU/cm <sup>2</sup>	4-hair FU/cm <sup>2</sup>
Left temporal	$4.9 \times 4 = 19.6$	$7.6 \times 4 = 30.4$	$1.8 \times 4 = 7.2$	0
Left parietal	$5.4 \times 4 = 23.6$	$8.5 \times 4 = 34$	$1.6 \times 4 = 6.4$	0
Central occipital	$4.1 \times 4 = 16.4$	$9.4 \times 4 = 37.6$	$2.8 \times 4 = 11.2$	0
Right parietal	$5.2 \times 4 = 20.8$	$8.6 \times 4 = 34.4$	$2.3 \times 4 = 9.2$	0
Right temporal	$4.9 \times 4 = 19.6$	$7.6 \times 4 = 30.4$	$1.7 \times 4 = 6.8$	0
Average no. of FU/cm <sup>2</sup>	20	33.3	7.93	0
Percentage (%)	32.5	54.2	13.2	0

 Table 3.2
 Breakdown of follicular units in each reference point in East and Southeast Asians

Excerpts from Retrospective Assessment of Follicular Unit Density in Asian Men with Androgenetic Alopecia. Ortega-Castillejos, MD, Pathomvanich MD. Dermatol Surg 2017; 43(5): Table 4, pp.675

**Table 3.3** Number of hairsper reference point (East andSoutheast Asians)

Reference point	Total no. of hairs/cm <sup>2</sup>
Left temporal	102
Left parietal	110.8
Central occipital	125.2
Right parietal	117.2
Right temporal	100.8
Average no. of hairs	111.2

Excerpts from Retrospective Assessment of Follicular Unit Density in Asian Men with Androgenetic Alopecia. Ortega-Castillejos, MD, Pathomvanich MD. Dermatol Surg 2017; 43(5): Table 7, pp.677

Table 3.4 Miniaturized hairs for East and Southeast Asians

Reference point	Number of miniaturized hairs/ cm <sup>2</sup>
Left temporal	$2.3 \times 4 = 9.44$
Left parietal	$1.74 \times 4 = 6.96$
Central occipital	$1.92 \times 4 = 7.68$
Right parietal	$1.68 \times 4 = 6.72$
Right temporal	$2.14 \times 4 = 8.56$
Average no. of miniaturized hairs/ cm <sup>2</sup>	7.8 hairs/cm <sup>2</sup>
Percentage (with reference to total no. of hairs)	7.0%
*Total no. of hair is 111.2/cm <sup>2</sup>	

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# **Chapter 4 Hair Characteristics of South Asians**



Radha R. Palakurthi and Raghuveer Palakurthi

#### 4.1 Introduction

Hair transplant surgery has gone through major refinements in the past three decades especially in terms of newer and innovative techniques. Learning hair characteristics specific to people of various geographic origins helps plan the surgery better and set realistic expectations for patients.

The data published on hair characteristics of South Asians is scanty. South Asians come from predominantly the Indian subcontinent along with Afghanistan and Maldives. The data presented here is collected from 1310 South Asian patients who underwent hair transplant surgery at the author's clinic located on the southeastern coast of India, Visakhapatnam, in the last 5.5 years.

The four hair characteristics that affect hair transplant results are colour, curl, calibre and density of the follicular unit. Hair protein called keratin is responsible for the physical characteristics [1]. The patient group included men (97%) and women (3%). These were from North (39%) as well as South India (57%), Bangladesh (0.4%), Nepal (0.2%) and Sri Lanka (0.4%) between age groups 24 and 61. South Asian hair was found to be black, either straight or wavy, with an average calibre of 0.062 mm (62  $\mu$ m) and an average follicular unit density of 84 per cm<sup>2</sup>.

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D. Pathomvanich, K. Imagawa (eds.), *Practical Aspects of Hair Transplantation in Asians*, https://doi.org/10.1007/978-4-431-56547-5\_4

#### 4.2 Hair Characteristics

#### 4.2.1 Colour

Contrast of hair to skin is significant in creating an illusion of fullness or thickness. Less contrast as in light hair over light scalp conceals more of the underlying bald area. South Asian hair was black in colour in 73% of the patient group, dark brown in 5%, grey in 13% and 'salt and pepper' in appearance in 9% of the patient group. South Indians by virtue of dark skin and black hair have less hair to skin contrast. North Indians have higher hair to skin contrast and therefore reveal the lacunae.

#### 4.2.2 Curl

The majority of hair samples were straight. The rest were wavy (see Fig. 4.1 and Table 4.1). Straight hair falls flat, whereas wavy hair adds volume by interlocking with adjacent hair. Wavy hair, mostly observed in South Indian patients, is of concern during FUE for risk of increased graft transection. However, the wavy hair had straight grafts.



**Fig. 4.1** The wavy hair with straight grafts typical of South Indian populace

**Table 4.1** Hair characteristics ofpatients at our clinic

Black and straight	64%
Black and wavy/curly	9%
Dark brown straight and wavy	5%
Grey and straight	13%
Grey and black 'salt-and-pepper' straight	9%

#### 4.2.3 Calibre

Hair calibre plays a vital role in bringing out greater volume to the transplanted hair. Hair at the mid-occiput region is usually of higher calibre than the temporal areas. In view of the better laxity as well as donor hair density in the occipital region, the major chunk of donor hair needs to be obtained from this region. This practice is in contrast to many surgeons from the West who harvest strips of uniform width.

Hair samples were collected from the mid-occipital region above the occipital notch. An average of the diameters of ten hair follicles was determined using a digital micrometre. It is stated that diameters less than 0.06 mm give a sparse quality to the transplant [1].

The author found the average diameter of hair follicles in men to be 0.062 mm. The minimum diameter was 0.042 mm and the maximum 0.09 mm. The average diameter in women was 0.058 mm, while the minimum and maximum diameters were 0.036 and 0.077 mm, respectively.

The fine temporal hair is useful for creating a natural-looking hairline. The occipital hair may be reserved for adding volume.

#### 4.2.4 Donor Hair Miniaturisation

There are limited publications on donor hair miniaturisation. Among the hair transplant procedures performed in the last 2 years at the clinic, miniaturisation was recorded in 14% of the patients. The percentage of miniaturised hair out of the donor harvest was not recorded for individuals. Hair less than 0.03 mm (30  $\mu$ m), less than 1 cm in length, hypopigmented and unmedullated is vellus or miniaturised hair. The maximum diameter of the miniaturised hair at the recipient site recorded was 0.036 mm (36  $\mu$ m). Therefore this donor hair bearing resemblance in diameter to the vellus hair was considered miniaturised (see Fig. 4.2).

The minimum age at which donor miniaturisation was recorded was 24 and the maximum was 51. Patients with hair calibre less than 0.06 mm (60  $\mu$ m) showed more chances of donor miniaturisation. The author used the miniaturised grafts for filling in inter-follicular spaces to add density rather than for primary coverage. Patients with donor miniaturisation were advised to take oral finasteride.

More scientific work is required to establish the prevalence of donor hair miniaturisation and thereafter the solution.

#### 4.2.5 Density

Follicular unit density (follicular unit grafts per square centimetre) is more applicable when planning the required number of grafts for a hair transplant procedure, rather than hair density which is the number of follicles per cm<sup>2</sup> [2]. Using a square



**Fig. 4.2** Miniaturised 1-hair (row 1) and 2-hair FU (row 2) in comparison to normal grafts (row 3)

centimetre template, donor hair density was calculated at two sites, mid-occiput and temporal regions using digital photography. The average of two readings was recorded. It was determined that South Asians have an average density of 89 follicular units (FU) per cm<sup>2</sup>. North Indians had 86 FU per cm<sup>2</sup>. But one hair grafts comprise approximately 30% of the harvest bringing down the hair density. Average density in women was 62 FU per cm<sup>2</sup> which is less than 70–75 FU per cm<sup>2</sup> reported by Damkerng Pathomvanich [3].

#### 4.3 Conclusion

The colour of South Asian hair is generally black and straight to wavy. These characteristics can be used to the patient's advantage in order to minimise hair and skin contrast and create a dense look. Hair calibre varies from a minimum of 0.042 mm to a maximum of 0.09 mm. Lower calibre helps create natural hairlines and higher calibre hairs have higher cosmetic value. Donor miniaturisation should be reported. Average follicular unit densities among South Asians are 84 FU per cm<sup>2</sup>, which is higher than that reported in Chinese and lower than Caucasians [4], but the hair density is low in view of one hair grafts comprising 30% of donor harvest, similar to 24–30% reported by K. Imagawa [5]. It is more challenging to achieve dense packing in women due to the lower average donor densities of 62 FU per cm<sup>2</sup>.

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# Chapter 5 Hair Characteristics of West Asians



Ali Abbasi, Ramin Rabbani, and Sheida Abbasi

#### 5.1 Background

Differences in hair characteristics have been described according to the ethnic background in African, Caucasian, and Asian. Asians are known to have fewer hairs than Whites [1].

Asia can be divided into two parts: West (the concept is in limited use, as it significantly overlaps with the Middle East) and East Asia. In Asian, hair parameters and characteristics have been studied mostly in East Asian, whereas few data on West Asian have been reported in the literature. West Asia is a territory and included three big subgroup ethnic, Persian, Turkish, and Arabian, so in West Asian there are more differences in hair characteristics (color, caliber, shape, density and in terminal-to-vellus hair ratio, and anagen-to-telogen ratio) but no differences in the intimate structures of fibers were observed among these three types of hairs [2].

Through research in medical literature, the author could not find more about Arabian and Turkish subgroup ethnics' hair characteristics, so this data is restricted to Persian (Iranian) subgroup ethnic and comparison with East Asia and Caucasian. Studies in Persian (Iranian) hair characteristic evaluated hair color, caliber, density, curl, and anagen-to-telogen and terminal-to-vellus hair ratio, in three regions of the scalp, vertex, temporal, and occipital areas. These studies demonstrated that there are significant differences between Persian and East Asia hair parameters.

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D. Pathomvanich, K. Imagawa (eds.), *Practical Aspects of Hair Transplantation in Asians*, https://doi.org/10.1007/978-4-431-56547-5\_5

#### 5.2 Evaluation of Persian Hair Characteristic

#### 5.2.1 Density

(Evaluation on Iranian hair count and density in children and adult)

#### 5.2.1.1 Density in Children

In a study done in 135 children, 70 males (51.9%) and 65 females (48.1%), aged 10–15 years old, average 12.5, without any hair and systemic disease (Table 5.1), the main density of hairs were on the frontal area, the average terminal hairs 288.78  $\pm$  58.83 and vellus 34.74  $\pm$  16.51 and total number of hairs were 323.58  $\pm$  66.34; on the parietal area, terminal hairs 199.28  $\pm$  61.46 and vellus 27.11  $\pm$  9.28 and total number of hairs were 266.44  $\pm$  65.55; on the temporal area, terminal hairs 234.78 and vellus 24.13 and total number of hairs were 258.78  $\pm$  60.34; and on the occipital area, terminal hairs 259.15  $\pm$  57.17 and vellus 32.8  $\pm$  15.76 and total number of hairs were 258.19  $\pm$  60.34 [3] (Table 5.1).

#### 5.2.1.2 Density in Adult

Another study in Iranian adult compared the number of hairs in normal male and female Iranian people in average age 30–33 year old and found out 37.7 hairs/4 mm.-punch for male and 33.1/4 mm.-punch for female, and for AGA males and females, the average age was 29.1 and 30.1/4 mm-punch, respectively; there is no significant difference between two groups in respect of terminal, vellus, total, and terminal count [4] and 1.92/hairs per follicular unit [5].

In another study of 400 men, 29–47 years old, who were type IV Norwood on the occipital area, the total number follicular units (FUs) were 36.3% 1-hair, 40% 2-hair, 19.3% 3-hair, 4% 4-hair, and 0.4% grafts of 5-hair. The mean number of hairs per follicular unit was 1.92 [5] and 97 FUs/cm<sup>2</sup> [4].

As shown in Table 5.2, the total hair density of Iranian is significantly higher than of other East Asian people.

And Tables 5.3 and 5.4 show the hair density of Iranian people in comparison with Asian and American White people and that Iranian hair count is the same or

	Terminal	Frontal vellus	Total no. of hair
Frontal area	288.87	34.74	323.52
Parietal area	199.26	27.11	226.44
Temporal	234.78	24.00	258.78
Occipital area	259.15	32.81	288.19

**Table 5.1** Comparing the mean density of terminal, vellus, and total hair per  $cm^2$  on different areas of the scalp of children 10–15 years old in the study

				Anagen/	Terminal/vellus
	Terminal hair	Vellus hair	Total hair	telogen hair	hairs
Persian [4]	$34 \pm 6.5$	2.4	36.4	93.7: 6.3	17.8:1
Thai [5]	$16.5 \pm 8.4$	$6.9 \pm 7.0$	$28.3 \pm 9.2$		
Korean [6]	$14.9 \pm 3.2$	1.1	16.1	93.6: 6.4	13.5:1
Taiwanese [7]	20.5	0.8	21.3	91.6:8.4	25.3:1
Chinese [8, 9]		s	24.3		

Table 5.2 Compare the hair follicle count on occipital by punch 4 mm in Asian population

 Table 5.3
 Comparison of normal hair count between Koreans, American Whites, and Blacks with Iranians [3]

	Persian (Iranian)	Korean [1]			American Whites [10]
		Asian	Thai	Taiwan	
Age (year)	35.5	35	34	36	43.5
Total hair	36.4	16.1	28.3	21.3	40.2

Table 5.4 Comparison Iranian FU with other ethnic

FU	Caucasian (%)	Koreans (%)	Japanese (%)	Thai (%)	Iranian (%)
1-hair	10	37	30	24	36.3
2-hair	40	38	50-55	64	40
3-hair	50	25	15-20	13	19.3
4–5-hair					4.4

close to White people and significantly higher than other Asian people. Compare the hair follicle count on occipital by punch 4 mm. in Asian population.

#### 5.2.2 Hairline in Persian

The most hairline shape in Persian (Iranian) is wide and flat with a curve in frontotemporal angle like East Asian people, up-sloping [12] considers this criteria (frontotemporal, parietal, and temporal hairline and apex) Fig. 5.1, in recreate normal hairline design is critical, because they often affect facial contours. Recreation of the temple in young adult usually necessitates some degree of lateral flare of the frontal hairline, but not in the older people (Figs. 5.2 and 5.3).

#### 5.2.3 Caliber

The avenge hair caliber in Persian men is #95  $\mu m$  compared with 71  $\mu m$  in East Asia and 70  $\mu m$  for Caucasian [11].

Fig. 5.1 The most hairline shape in Persian (Iranian) is wide and flat with a curve in frontotemporal angle like East Asian people





Fig. 5.2 Design the hairline in Persian (Iranian)



Fig. 5.3 Recreation of the temple in young adult usually necessitates some degree of lateral flare of the frontal hairline, but not in older people

#### 5.2.4 Color

Mostly, Persian people have dark to black hair.

#### 5.2.5 Shaft

Straight.

#### 5.3 Length of Hair Follicle

Considering the length of hair follicle from epidermis to dermal papillae (in anagen phase of hair follicle) is very important; the average length of hair follicle in Persian people is #4.5 mm in comparison with East Asian and Caucasian which is 5.5 and 4.5 mm, respectively; so in FUE method, in order to prevent to transection, considering the length of hair follicle is very important, because the chance of transection increases with increase the length of graft.

#### 5.4 Patient Selection

The incidence of keloid or hypertrophic scar especially in younger people on harvesting and recipient, with each method (FUT or FUE) in Persian people, is like as East Asia, and keloid formation in people prone to keloid is more in FUT method than FUE. In FUT method, in order to prevent keloid formation, the donor strip should excise longer and narrower, should use trichophytic closure to minimize the linear scar, and so should be cautioned and screened for these problems before method selection of surgery and during consolation session.

#### 5.5 Donor Harvesting Considerations

Today, two methods FUE and FUT are popular in West Asia.

#### 5.6 Recipient Consideration

For achieving natural hairline and desirable cosmetic density, in recipient area, in Persian people, three important points should be considered:

- 1. Creating a wide flat, some degree of lateral flare of the frontal hairline and rounded frontotemporal angle.
- 2. The normal density is 30–40 FUs/cm<sup>2</sup>, and more than 40 FUs/cm<sup>2</sup> is questionable for survival graft and regrowth (Fig. 5.2).
- 3. Consider the hair direction flowing from left to right [12], and in order to prevent of postoperative edema (with any method FUT or FUE) the days after surgery and hair growth outcome, using Abbasi solution (Saline Normal 100 cc + Epinephrine 1/1000 1 mL + 40 mg Triamcinolone) [13, 14], is recommended.

#### 5.7 Conclusion

According to the above information about Iranian hair characteristics (more density, thicker diameter of hair shaft and hairs in follicle units) in FUE method, we cannot use the regular punch size that is usually used in other Asian people; in other words, it needs a slightly larger punch size than other Asian people (1 mm punch or more), so the final result is clear: the fine white pinpoint scar in Iranian people in FUE is more visible than other Asian and Caucasian people because of used larger diameter punch, and in FUT method the donor strip should excise longer and narrower and use trichophytic closure to minimized the linear scar.

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# Chapter 6 Diseases of the Hair and Scalp in Asians that are of Interest to Hair Surgeons



M.J. Kristine Bunagan

#### 6.1 Introduction

The relevance of hair and scalp diseases as it affects hair transplantation largely depends on the underlying nature of the disease, whether the disease may be induced or worsened by the surgical procedure or the possibility of the condition interfering with some of the procedural techniques. For instance, papulosquamous diseases such as psoriasis and seborrheic dermatitis could flare up because of the hair procedure, while transplanted grafts in patients with cicatricial alopecia would most probably shed eventually due to the underlying disease process. The relevance and recommended actions for each pertinent hair and scalp disease are summarized in Table 6.1.

#### 6.2 Noncicatricial Alopecias

#### 6.2.1 Alopecia Areata

The concern with this disease is the possibility that affected hair follicles would undergo hair shedding postoperatively in cases where a patient with alopecia areata (AA) has undergone hair transplantation. The occurrence of lesions is unpredictable, and the disease may recur at any point in time; thus it is important to diagnose this condition in a potential hair transplantation candidate.

The common patchy type of alopecia areata (AA) appears as alopecic nonscarring patches which can be readily diagnosed clinically (Fig. 6.1) [1]. The diffuse

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D. Pathomvanich, K. Imagawa (eds.), *Practical Aspects of Hair Transplantation in Asians*, https://doi.org/10.1007/978-4-431-56547-5\_6

Hair diseases	Relevance to HT	Diagnostics/management prior and/ or after HT
Alopecia areata (AA)	Diffuse variant clinically may appear similar to pattern hair loss (PHL) HT not indicated for AA due to risk of grafts shedding due to underlying disease	Dermoscopy: AA—exclamation point and broken hairs PHL—varying hair diameters and miniaturized hairs Biopsy if still in doubt
Psoriasis	Psoriatic lesions may be induced or aggravated by trauma (Koebner phenomenon) thus treatment prior to HT	Mild to moderate—tar-based shampoo and topical steroid Severe—above plus systemic drugs (e.g., methotrexate or acitretin)
Seborrheic dermatitis	Lesions of scaling and pruritus may worsen after the procedure	Tar, salicylic, selenium, or ketoconazole shampoo Corticosteroid lotion/solution (e.g., triamcinolone) may be used for acute flares
Cicatricial alopecia (e.g., lichen planopilaris (LPP)) Frontal fibrosing alopecia (FFA)	In pre-existing disease any transplanted grafts may eventually undergo shedding and scarring due to underlying disease Risk of developing LPP following hair transplantation procedure FFA appears similar to frontotemporal recession seen in the Norwood Hamilton type of hair loss (mostly women)	Dermoscopy of perifollicular scaling, erythema, and scarring (lack follicular ostia) May have symptoms of pain and burning sensation Biopsy needed to confirm diagnosis
Telogen effluvium (TE)	Confusion with TE is mainly seen in women with PHL due to diffuse thinning over the midscalp or vertex area HT not indicated for thinning due to TE	Excessive hair shedding leading to diffuse hair thinning with no discernable pattern Hair pull test positive for active TE and negative for PHL Dermoscopy PHL—varying hair diameters and miniaturized hairs TE—hairs of same caliber and minimal miniaturized hairs
Seborrheic keratosis (SK) and skin cancer	Larger SK in the recipient area may interfere with slit creation and insertion of grafts	No need to biopsy SK. Remove with electrocautery and curettage Biopsy needed for skin cancers. Surgical management recommended
Trichorrhexis nodosa (TN)	Case study of TN following hair transplantation	Dermoscopy or light microscopy of hair shaft Nodal swellings consisting of fiber fraying and splaying appearing like ends of a brush

Table 6.1 Summary of hair diseases relevant to hair transplantation (HT) with management recommendations



Fig. 6.1 AA common patchy type

variant of this disease is the one of concern due to the lack of well-demarcated alopecic lesions. Rather the patient complains of diffuse thinning which may even appear similar to pattern hair loss (PHL) or androgenetic alopecia (AGA) in cases affecting the midscalp or vertex area [2]. Since clinically the features of diffuse AA are not apparent to the naked eye, the use of a dermoscopy device can be helpful in identifying exclamation point hairs and broken and dystrophic hairs which are features of AA (Fig. 6.2). In contrast PHL or AGA on dermoscopy would show primarily miniaturized hairs or hairs in varying diameters to signify the miniaturization process (Fig. 6.3) [3]. In cases where there is still doubt of the diagnosis, then a skin punch biopsy should be performed.

In some cases a patient may have undergone hair transplantation with good growth of transplanted grafts but may then develop alopecia areata years later, seemingly independent and unrelated to the hair surgery. This occurred in a patient of the author wherein there was hair shedding and thinning over the midscalp area about 3 years after the transplanted hairs had successfully grown well. Clinically only diffuse thinning was apparent, and only on dermoscopy were the exclamation point and broken hairs seen indicating diffuse AA. In these situations, treatment with topical (e.g., clobetasol or betamethasone dipropionate ointment) and



intralesional corticosteroids (2.5-5 mg/mL triamcinolone) leads to regrowth of the

6.2.2 **Telogen** Effluvium

affected areas [2].

Patients with the primary complaint of hair shedding and who upon examination show diffuse hair thinning without any discernable pattern should be evaluated for the possibility of telogen effluvium (TE). History for the past 2-6 months prior to the condition has to be probed to ascertain the probable trigger of the condition (e.g., febrile illness, systemic disease, medications, childbirth, surgical procedures, or significant psychological stress) [4, 5]. The patient usually complains of

Fig. 6.2 Dermoscopy of broken and dystrophic hairs seen in AA

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excessive shedding of more than 100-150 hairs per day. This could be telogen effluvium or less commonly bouts of active shedding in pattern hair loss (PHL) which may occur at certain intervals indicating disease progression. PHL in general manifests as gradual hair thinning without apparent excessive hair fall, and confusion with TE is mainly seen in early female pattern hair loss (FPHL) where there is diffuse thinning over the midscalp or vertex area. A dermatoscope would be helpful to appreciate the significant number of hairs with varying diameters signifying miniaturization in FPHL as compared to TE which would have hairs of same caliber and very minimal miniaturized hairs if any. A hair pull test can also be done and would vield positive results for active TE. If TE has been established, then control or resolution of the condition would be possible with avoidance or correction of the triggering factor(s). It should be explained to the patient that hair transplantation is not the solution to the hair shedding. In cases where there is PHL and TE concomitantly and the patient asks about the possibility of hair transplantation for the PHL, then it should be discussed with the patient that this hair procedure would be better done after the problematic hair fall has normalized.

#### 6.3 Cicatricial Alopecias

The main focus is the primary cicatricial alopecias (e.g., lichen planopilaris (LPP), discoid lupus erythematosus) due to the eventual permanent destruction of hair follicles. In cases with active pre-existing disease, any transplanted grafts over the recipient site would be affected wherein growing hair follicles would eventually undergo hair shedding and irreversible scarring due to the underlying disease process. In inactive disease the hair transplantation process can be a triggering mechanism which activates the disease with the same outcome of eventual destruction of the hair follicles over the recipient or donor area. Several studies have reported the development of LPP following a hair transplantation procedure with a time interval ranging from 4 to 36 months post operation [6-8]. Although in many cases patients undergoing hair transplantation may not manifest any signs and symptoms of cicatricial alopecia, it is recommended that a thorough examination of the scalp be performed as well as a symptom check of patients with suspicion of primary cicatricial alopecia. In the early stages, dermoscopy may show perifollicular scaling and erythema (Fig. 6.4) with minimal alopecic scarring. Other clues to the possibility of scarring alopecia are the symptoms of pruritus, pain, and burning sensation. A skin punch biopsy is needed to establish the diagnosis and to properly exclude the condition before proceeding with the surgical procedure [8, 9]. As of the present, there are no clear predictive or risk factors which would help determine who may develop a primary cicatricial alopecia following hair transplantation; thus a strong index of suspicion is needed.

Aside from LPP (mainly the classic more common variant affecting the scalp), DLE can also be seen in the Asian population. The occurrence of frontal fibrosing