Natural hairline density in men: findings of a pilot survey

Sharon A. Keene, MD Tucson, Arizona

The hairline area is a critical component to re-create cosmetic results and naturalness in hair restoration surgery because this area receives the most direct visual scrutiny. Location and shape are important aspects, and so is the graft type and hair density. Patients are often lured by the offer of “maximum follicular unit density” on the Internet, with the implicit assumption that hairlines of greater follicular unit density have optimal cosmetic value. It has already been established that different areas of the scalp have naturally occurring, different follicular unit densities, with the mastoid and mid-occipital areas revealing the greatest density, and areas of the crown and supra-auricular region noted to have fewer follicular units and less hair. However, it is notable that there has never been a scientific evaluation of hairline density to determine what should be re-created. In the absence of scientific validation, any assertion is difficult to refute since people are often under the impression that when it comes to hair on the head, “more is better.” Years of experience have taught us that more hair or more grafts, without consideration of factors such as optimal distribution and natural groupings, is not, in and of itself, a cosmetic advantage. Therefore, the rationale for a population survey of natural hairline density is threefold:

1. Observation reveals that hairline areas (temple regions) in patients undergoing hair restoration surgery often appear to have fewer follicular units per square centimeter compared to the donor area or naturally occurring areas adjacent to the recipient zone. The question then arises: Is this true for people without androgenetic alopecia? If so, then naturalness would dictate less follicular unit density in the hairline area compared to donor and other areas (which is consistent with the concept of a transition zone of hair, and not a wall).

2. In order to re-create natural appearing hairline density, it is necessary to know what constitutes natural density, or the numbers of hairs and/or follicular units per square centimeter at the hairline. Hairline refers not only to the frontal hairline but also the temporal area and temporal points.

3. It also follows that grafting higher density than what occurs naturally is unnatural, unnecessary, and not a judicious use of limited donor hair resources.

Based on these contentions, a hairline density survey was initiated as a preliminary effort to assist hair restoration surgeons to achieve natural appearing density, while avoiding the waste of finite and sometimes scarce resources.
President’s Message

William M. Parsley, MD
Louisville, Kentucky

In spite of a global downturn in the economy, I hope the start of the New Year finds everyone healthy and busy in their practices. 2009 is a very special year. It is a special anniversary for the two most important articles in the history of hair restoration.

One created our field, and the other revolutionized it. In 1959 (50 years ago), Dr. Norman Orentreich, a dermatologist in New York, published a study on donor dominance, which included alopecia, in the Annals of the New York Academy of Science. According to Dr. Hiram Sturm, who assisted with these original studies, it had been rejected by the Archives of Dermatology with an explanation that the results were “not possible.” The finding that hair grew in the transplanted grafts was accidental, as investigating vitiligo was the main purpose of the study. Even so, it would have probably been overlooked had the patient not pleaded with them to put more grafts into his balding scalp. This is typical of the field of hair restoration in that it has been driven more by patient requests than by doctors.

Dermatologists tend to gather skin tissue by using round punches (trephines) and this was what was used for this study. And so for the next 30 years, round punches (usually 3.5-4.5mm in diameter) were the primary tool for harvesting grafts and creating recipient sites in hair restoration. Early techniques would have almost certainly been more advanced if the studies of 4 early Japanese pioneers had been accessible. Dr. Okuda used round grafts similar to Dr. Orentreich in 1939; but during this earlier era, Drs. Sasagawa, Tamura, and Frijita used mini and micrografts similar to what were developed 20 years after Dr. Orentreich’s article. But there is little doubt, however, that Dr. Orentreich’s study created modern hair restoration.

1994 (15 years ago) brought the article that revolutionized hair restoration. Dr. Bobby Limmer’s “Elliptical Donor Stereomicroscopically Assisted Micrografting as an Approach to Further Refinement in Hair Restoration” was published in Dermatologic Surgery. This was the introduction to what is now called Follicular Unit Transplantation. Even though Dr. Limmer was a dermatopathologist as well as a dermatologist, he didn’t immediately connect his work to Dr. Headington’s 1984 original article describing follicular units. That connection was relayed to Dr. Limmer independently by both Dr. O’Tar Norwood and Dr. Bob Bernstein. But pictures of his grafts included in the article make it perfectly clear that the created grafts were indeed follicular unit grafts. After this article, large round grafts disappeared. Nearly all rotation flaps were abandoned except for reconstruction. Advancement flaps were also mostly abandoned, with only a handful of doctors continuing to perform midline scalp reductions (normally 1-2 midline excisions with the aid of the Frechet extender, and then followed finally by a triple rotation flap to restore the crown whorl). Mini-grafting was drastically reduced over the next 10 years. Hair restoration at the end of the 1990s was a far different field than the field we knew entering that decade. While it was a landmark article for the field of hair restoration, Dermatologic Surgery didn’t list it on the cover as one of the marquis articles for that issue. Similar to Dr. Orentreich’s article, major advancements often aren’t appreciated at the time, perhaps because they represent too big a leap.

In conversations with Dr. Limmer, the use of a stereomicroscope came while he was trying to create finer grafts. While teaching medical students in Texas, he “borrowed” a stereomicroscope from the dental school for several months. Grafting was drastically reduced over the next 10 years. Hair restoration at the end of the 1990s was a far different field than the field we knew entering that decade. While it was a landmark article for the field of hair restoration, Dermatologic Surgery didn’t list it on the cover as one of the marquis articles for that issue. Similar to Dr. Orentreich’s article, major advancements often aren’t appreciated at the time, perhaps because they represent too big a leap.

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A few months ago I received the following email asking for hair transplant information: “Dr. Jimenez, I need 3,000 grafts. My donor density is 90-100 follicular units/cm², and my recipient area will have a density of 40-45 FU/cm². That means that my donor scar would have to be 33cm² (3,000/95), that is 1cm wide and 33cm long....”

Does this fellow understand that the number of grafts is not the only variable that matters in hair transplantation? Does he care about the thickness of the hair? Does he understand the risks of future hair loss?

I see more and more emails like this: people (mostly distrustful) telling the surgeon what to do, and Internet shopping at a number of clinic websites (for a better price and for more hair) as if we were “hair sellers by weight or by numbers.” Sincerely, I miss those good old times when patients would say: “Doc, I want you to help me and put more hair on my scalp. Do whatever you think is best for me.” Oh what happy days!

Be aware of a new major figure that has just made its appearance in the field of hair research: the Lgr5 (leucine-rich G protein-coupled receptor 5). Dr. David Whiting mentions it in his interview in this issue’s Hair Sciences column. Lgr5, a marker of stem cells in the small intestine and colon, is also expressed in human hair follicles by cells with regenerative and stem cell-like capacity (Jaks, et al. Nat Genetics 2008; 242:44-57). However, these experiments suggest that the bulge is not the only source of stem cells, it being possible that the ORS contributes to the progenitor pool to regenerate the follicle during the anagen phase. The debate is out there and more studies on this molecule will certainly appear in the coming months.

Paco Jimenez, MD

High densities, although technically achievable, may not be necessary in certain recipient zones, and, in this issue, Sharon Keene reports her measurements of hairline densities as they naturally occur in men without androgenetic alopecia. The results of her pilot survey can direct us towards our goal, which, after all, is mimicking nature and preserving donor hair.

Next, Joseph Greco and Robert Brandt study the effects of intralesion platelet rich plasma (PRP) on hair miniaturization and Richard Keller, et al. present a reproducible technique using anatomic landmarks to identify two important design features: the fronto-temporal apex and the temporal point.

Kongjat Laorwong, et al. present a novel source of donor hair (sideburns) for eyebrow transplantation and Jerzy Kołasinsky presents the accuracy of TrichoScan® technology compared to currently used methods for measuring hair density and hair miniaturization. He describes possible applications of this tool in assessing hair loss patients prior to medical as well as surgical treatment.

Bertram Ng and Damkerng Pathomvanich clarify whether we should refer to post-surgical hair loss as “telogen” or “anagen” effluvium. In addition, we are privileged to present an interview with Dr. David Whiting, one of our esteemed Basic Science Contributors, who discusses indications for scalp biopsy in women as well as various relevant opinions on scarring alopecias. Along with our usual features, I hope that this issue is full of pearls and techniques that you will incorporate into your practice.

Bernard Nusbaum, MD

As we approach our 1-year anniversary as Co-editors of the Forum, we would like to thank you for submitting your ideas, techniques, and research. To expedite the review process and to assert our commitment to sharing knowledge for the purpose of improving patient results, we have developed the following guidelines for your submissions.

**Editorial Guidelines for Submission and Acceptance of Articles for the Forum Publication:**

1. Articles should be written with the intent of sharing scientific information with the purpose of progressing the art and science of hair restoration and benefiting patient outcomes.
2. If results are presented, the medical regimen or surgical techniques that were used to obtain the results should be disclosed in detail.
3. Articles submitted with the sole purpose of promotion or marketing will not be accepted.
4. Authors should acknowledge all funding sources that supported their work as well as any relevant corporate affiliation.
5. Trademarked names should not be used to refer to devices or techniques, when possible.
6. Although we encourage submission of articles that may only contain the author’s opinion for the purpose of stimulating thought, the editors may present such articles to colleagues who are experts in the particular area in question, for the purpose of obtaining rebuttal opinions to be published alongside the original article. Occasionally, a manuscript might be sent to an external reviewer, who will judge the manuscript in a blinded fashion to make recommendations about its acceptance, further revision, or rejection.
7. Once the manuscript is accepted, it will be published as soon as possible, depending on space availability.
8. All manuscripts should be submitted to both drnusbaum@yahoo.com and jimenezeditor@clinicadelpelo.com
9. A completed Author Authorization and Release form—sent as a Word document (not a fax)—must accompany your submission. The form can be obtained in the Members Only section of the Society website at www.ishrs.org.
10. All photos and figures referred to in your article should be sent as separate attachments in JPEG or TIFF format. Be sure to attach your files to the email. Do NOT embed your files in the email or in the document itself (other than to show placement within the article).

**Submission deadlines:**
- April 5 for May/June 2009 issue
- June 5 for July/August 2009 issue
that jumped to over 100 in the second case. Today, sessions of over 4,000 grafts aren’t uncommon. But it is surprising how much Dr. Limmer got right, making further advances difficult for the next few years. While a major advancement, it is fair to say that Dr. Limmer’s work was a culmination of the efforts of several doctors over many years to create smaller, more natural grafts. Drs. Barnett, Ayers, Nordstrom, Marritt, and others were early leaders in developing smaller grafts (minigrafts). The Moser Clinic presented a very interesting technique called non-tufted incisional slit grafting three years before the Limmer article. It consisted of small minigrafts with the epidermis (tuft) removed to create a smoother junction with the skin. But these were all mini-grafts with little trimming of intrafollicular skin and with no great attention to the preservation of intact follicular units. Still, their advancements helped pave the way for follicular unit grafting, and some very experienced doctors still find that minigrafting combined with follicular unit grafts has advantages.

Our field has seen a number of very important articles, but none that have influenced the field so significantly. But they will certainly be joined by future landmark articles. Will they be on robotics, storage solutions for indefinite periods of time, or a stem cell breakthrough? Or something else?

Bill Parsley, MD
The pursuit of perfection

Many innovations in our field of hair restoration surgery have been influenced by patient preference. An early example was the temporary consumer popularity of synthetic single-“hair” (fiber) implantation that seemed to have better cosmesis than standard plug grafts. I believe this helped influence the development of smaller grafts resulting eventually in the development of follicular unit transplantation. A more recent example is patient concern regarding donor scarring influencing the development and popularity of follicular unit extraction (FUE) and the later development of trichophytic donor closures in response.

Any temptation for complacency on our behalf, by believing that we have reached our end-point of the refinement of our grafting techniques, should note that we now have patients asking us to provide their surgery on the condition that there is no visible scarring anywhere on the scalp—even when the scalp is shaved clean!

I was reminded of the ever increasing patient demands for perfection in our results by a comment a well-renowned colleague made to me in Montréal. He stated that “densely packed single hairs just look better than even FU grafts.” Is this really going to be the next “gold standard”? Is this implying that we can create a result superior to nature? Or, rather, is it acknowledging that almost all FUT cases are performed at considerably less-than-normal density with resulting minor irregularities in reduced density that fail to meet the goal of “perfection”?

So, where does this all stop? The continued innovation and refinement of techniques seek to “raise the bar” on our results with the implication that, generally, patients will then be happier. But, is this a true paradigm?

Surgeons who are serious about their work do continually seek to improve techniques even when the cost of doing so is much higher. The current popularity of maxi-session, single-pass surgery that requires maxi-staffing is a case in point. Consider also the development of FUE and the impending push toward robotics for FUE.

But, is perfection an appropriate goal? After all, isn’t hair transplantation the art of cosmetic illusion whereby remaining hair is partially redistributed to “fool the eye” into believing greater coverage exists than in reality?

The pursuit of perfection conceivably assumes that most patients want perfect results, which discounts the reality, learned over many years, that patients are generally quite happy with what has been achieved with our current techniques. As well, most patients want a result they can justify financially (which is not necessarily the same thing as what they can afford). How many patients tell us they don’t care about the cost, just the result?

There is nothing wrong with attempting to improve our results. Improving our average outcomes (i.e., reproducibility) is the single most important improvement we should seek. Increasingly, our results depend almost entirely upon the skills and technique of our surgical teams, coupled to the surgeon’s design. It is hard to blame the patient for poor outcomes. They cannot reject their own tissue after all. Disappointing growth rates are almost always our fault. I specifically take responsibility for this at the consult to reassure the patient that the post-operative phase is quite simple and predictable.

It is also my contention that failure to meet patient expectations (creating disappointment) is also partially our fault as we allow unrealistic expectations to survive the consultation, the operation, and the 6 months’ post-operative period.

Who are the patients that demand perfection? In my experience, they include the following:

1. **Body Dysmorphic Syndrome patients.** These people should be excluded from our surgical lists and offered psychological evaluation.
2. **Obsessive-personality patients.** These patients often arrive from other surgeons with good to excellent results but are very unhappy with the result.
3. **People with the least amount of hair loss/balding (of any age).**
4. **The very young** (e.g., less than 23 years old).

Why should we try to meet these expectations? Perhaps with the eventual nirvana of stem cell/cell culture techniques, we might only be limited by the patient’s budget and the pursuit of perfection in these individuals might become practicable.

However, the ability to achieve which has been termed the “esthetic durability” of the perfect result demands either no progression of balding or sufficient donor hair for all future needs. Is this realistic? Of course not, despite advances made in this regard by finasteride and dutasteride.

Single-pass transplants and “normal density” FUT are potentially dangerous and illusory concepts that over-simplify a complex evolving problem—Male Pattern Baldness (MPB)—and promise over-optimistic solutions to patient desires for “instant gratification.” How many times have we heard patients tell us they don’t want to keep taking medication, they just want a permanent solution achieved with a single surgery? This naïve belief stems from patients mistaking our treatments for a cure.

Surely it remains safer to continually lower patient expectations regarding “perfection” or esthetic durability. The exception regarding durability might be the older patient with extensive baldness who may almost be “stable.” My solution has been to use the analogy of the “leaking bucket.” I explain that MPB is like a leaking bucket, but that you are leaking hair. Medication is designed to partially or, hopefully, totally, “fix the leak.” Surgery is designed to “top up the bucket.” I tell them that topping up the bucket without fixing the leak produces only a temporary benefit. They then may need further top-ups (if donor hair is available).

The “perfect” result and reality are usually two quite different things. An alternative strategy is one I call “minimum comfort level.” When a patient asks me, “How much hair do
I need?” I define the “finish line” or goal as one that is unique to each patient. I tell them we may not be able to exactly describe or define the goal, but most patients will “know it when they see it.” I then say that my goal is to achieve it using the least amount of grafted hair. This leaves some hair in the “donor bank” for future needs.

Thus, in a world where, ironically, the result of our ever increasing quality of result has been the attraction of ever-more-demanding patients, could it perhaps be that the “best clinics” are those that best set and meet patient expectations regarding outcomes?

Call for Nominations

2009 Follicle Awards

GOLDEN FOLLICLE AWARD — Presented for outstanding and significant clinical contributions related to hair restoration surgery.

PLATINUM FOLLICLE AWARD — Presented for outstanding achievement in basic scientific or clinically-related research in hair pathophysiology or anatomy as it relates to hair restoration.

DISTINGUISHED ASSISTANT AWARD — Presented to a surgical assistant for exemplary service and outstanding accomplishments in the field of hair restoration surgery.

How to Submit a Nomination:
Include the following information in an e-mail to: info@ishrs.org
• Your name,
• The person you are nominating,
• The award you are nominating the person for, and
• An explanation of why the person is deserving; include specific information and accomplishments.

Nominating deadline: April 16, 2009

See the Member home page on the ISHRS website at www.ishrs.org for further nomination criteria. All awards will be presented during the Gala at the ISHRS 17th Annual Scientific Meeting, July 22-26, in Amsterdam, The Netherlands.

2009 Research Grant Application Deadline: March 16

Research Grants Available

1. The annual ISHRS research grants with amounts of up to US$1,200 per grant.

2. In addition, one grant is being offered for US$10,000 via a joint program between the ISHRS and the International Hair Research Foundation (IHRF).

The deadline for all grant applications is
Monday, March 16, 2009

Further information and a full application can be obtained on the ISHRS website at http://www.ishrs.org/member-grants.htm
Materials and Methods

The project initially was intended for 50 randomly selected men, aged 25-80 years, with little or no hair loss, in order to achieve a cross section of data from a wide range of ages, including men who would never be expected to experience androgenetic alopecia. All participants were aware during the initial inquiry that hair trimming would be involved, and patients with very short or shaved hair were the focus of our recruiting efforts. Participants received a pair of movie theatre tickets as compensation for their time.

No investigational review board (IRB) approval was necessary because this was a survey only, and no medical or surgical intervention occurred.

Specified areas (1 cm²) in the hairline, including frontal, temporal apex, and temporal point areas, were digitally photographed using 10× magnification. Images were downloaded, and follicular units were circled, and numbered to achieve the count (Figure 1). Initial plans to record 3 areas of the temporal hairline, including a point between the apex and temporal point, were amended to just 2 areas—temporal point and apex—for efficiency and to reduce time required for the patients, as well as the cosmetic inconvenience of hair trimming. Follicular unit density in non-hairline/frontal and mid-occipital (donor) regions were also sampled (Figure 2) but were not tabulated.

Density of follicular units in each of the 1 square centimeter areas on both the right and left sides of the hairline were tabulated for the group to provide statistical range, mean, and median.

The equipment used for the global photographs was a Nikon Coolpix 995, 3.3 megapixel digital camera. Magnified digital photos of the trimmed scalp hairs was performed using a Coscan handheld dermoscope with 10× magnification attached to a PC. Counting of follicular units was performed manually as previously described, and mathematical tabulations were performed using the Microsoft Excel statistical analysis package.

Results

Recruitment of patients for 2 months yielded only 14 patients who fit the inclusion criteria. Patients with obvious thinning, even when isolated to the crown, were excluded in an effort to establish non-thinning follicular unit density in the surveyed areas. Age of participants ranged from 21-77 years of age, with a mean age of 41 and median of 39. Results of the surveyed hairline densities are indicated in Table 1.

<table>
<thead>
<tr>
<th>Area Surveyed</th>
<th>FLU/cm² Range</th>
<th>FLU/cm² Median</th>
<th>FLU/cm² Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal Hairline</td>
<td>38-78</td>
<td>51.2</td>
<td>52.1</td>
</tr>
<tr>
<td>Temporal Apex</td>
<td>25-64</td>
<td>43.7</td>
<td>43.2</td>
</tr>
<tr>
<td>Temporal Point</td>
<td>24-59</td>
<td>39</td>
<td>40.5</td>
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Discussion

From a statistical perspective, a population survey of this size is too small to extrapolate with certainty—the confidence interval, and the confidence level (likelihood that the findings represent a larger population), is statistically limited. Small surveys are only accurate if the subject of the survey is a common finding in most members of the general population. For example, it does not take a large survey to ascertain that most human beings have two arms and two legs. However, until this hairline density survey includes a larger population sample to confirm these findings, it must be considered a pilot survey. In order to achieve a confidence interval of ±10% with a 95% confidence level, using a sample size calculator supplied online for survey data, a sample size of at least 96 patients is required (www.surveysystems.com/sscalc.htm). The usefulness of a pilot survey is to help identify aspects of data collection or study parameters that could be changed in order to improve the quality of information or efficiency in gathering it. However, even from this small pilot study, there are useful findings. First, it is interesting to note that when we compared donor density from the majority of patients in this sample to the study performed by Jimenez et al., where average occipital donor density was 65-85 follicular units per cm², results were very similar.

This finding suggests that the densities of the patients in this sample may reflect the findings of other larger patient samples. Although a relatively wide range of follicular unit density was observed between these individuals—the average and median densities were between 40-52 FLU/cm² for all hairline areas—only the highest end of the hairline density spectrum was in the 70s. If adjacent areas to most hairlines do not approach this density, and if natural density occurs most often at 40-50 FU/cm², it begs the question of a rationale for more. This is especially true since patients with AGA may experience progressive hair loss, and preserving a donor supply for future use is advantageous. The highest density in this survey occurred in the youngest patient, and younger patients tended to have greater FU density, suggesting that older men, even without visible AGA, may experience some loss of follicular unit density—and still appear to have normal cosmetic hair density. It was also observed that those patients with higher follicular unit density often had fewer hairs per follicular unit (more 1-2 hair follicular units); conversely, it was observed in the donor area that patients with a large number of 3- to 4-hair follicular units had fewer follicular units per square

In future surveys, absolute hair counts, in addition to FU counts, will offer more meaningful information since FU density in the absence of hair counts may imply a greater range of hair density than truly occurs.
centimeter. (See Figures 3 and 4 for comparison.) In other words, there appears to be a natural tendency for compensatory increases in FU density when there are fewer hairs per FU, and decreases in FU density when there are more 3- to 4-hair FUs in order to create a given number of hairs/cm$^2$ in certain areas of the scalp. This observed finding in nature, interestingly, mirrors the surgical technique of using double follicular units (i.e., combining a 1-hair FU with a neighboring 2-hair FU to create a 3-hair graft, also known as “recombinant grafts” or follicular families) in order to increase the number of 3- to 4-hair grafts while reducing the number of grafts needed to achieve a certain hair/cm$^2$ density.

This finding is consistent with the supposition that observed density is not just an issue of follicular unit density but, also, absolute number of hairs. Therefore, in future surveys, absolute hair counts, in addition to FU counts, will offer more meaningful information since FU density in the absence of hair counts may imply a greater range of hair density than truly occurs. (For example, 50 1-hair FUs in this survey looked similar in cosmesis to 35 FUs when the latter included a combination of 1- to 2-hair FUs, and hair counts were comparable). Other observed contributing factors include hair characteristics that were not included in this survey. For example, coarse and curly hair could be expected to be associated with decreased follicular unit density in order to make room in the subcutaneous space for the convoluted, curved, or larger hair follicles. In contrast, patients with fine, straight, silky hair would be anticipated to have more hairs per square centimeter. Ethnicity was not considered in this study, but should be as it has been reported that ethnic variation exists with respect to hair density. For example, Caucasians reportedly have the most density, followed by African hair and then Asians. It seems logical that the cause of this variation is ethnic diversity in hair characteristics, such as kinky or coarse hair, and this may contribute to differences in follicular unit density in the hairline also.

Finally, although the effort of this survey was to include only men without obvious patterned hair loss, a similar survey of hairline and adjacent area density should be performed in patients with AGA, since grafted densities will appear unnatural if they greatly exceed adjacent area densities, especially if additional thinning occurs in these areas in the future.

**Conclusion**

A pilot study of naturally occurring hairline density was performed. Preliminary findings indicate that follicular unit density in the hairline is usually significantly lower than donor density, and attempts to make hairlines equal to donor density are contrary to what occurs in nature. However, the small sample size in this survey prevents conclusive proof of this finding. A larger survey should be undertaken, and additional stratification and data should include parameters such as absolute hair count/cm$^2$ as well as FU/cm$^2$, age, race, and hair characteristics. This same survey should then compare men with AGA as well as those without thinning. Since patients and doctors must currently deal with the finite limitations of individual donor supplies over a lifetime, finding the lowest hair density that re-creates natural hairline density is advantageous. Using more hair than occurs naturally offers no justifiable advantage, certainly not improved naturalness. For those with limited donor supplies, finding the smallest number of hairs that achieves the illusion of density is of greater importance. The first step to achieving these goals is to know what natural density is. This will not only provide us improved technical guidance, it will offer scientifically sound recommendations for patients to follow when asking for “maximum density.”

**References**