Inframammary Crease: Positional Relationship to the Pectoralis Major Muscle Origin

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Background: The inframammary fold (IMF) is an important anatomic landmark in breast surgery. Despite the importance of this structure, its relationship to the pectoral muscle and its position on the chest wall are not fully understood.

Objective: The purpose of this article is to identify the positional relationship of the inframammary crease to the pectoralis major muscle.

Methods: The study included 20 female cadavers and 10 patients with breast cancer with planned mastectomies. The course of the inframammary crease was tattooed to the underlying chest wall with marking needles and methylene blue dye. Marking needles were placed along the fold at the midclavicular line, 2 cm medial to the midclavicular line and 2 cm lateral to the midclavicular line. After removal of overlying soft tissue, measurements were made between the IMF markings and the inferior origin of the pectoralis major muscle. Chest walls of the cadavers were examined bilaterally.

Results: The IMF was located inferior to the inferior origin of the pectoralis major muscle in all measurements of all specimens. The average distance of the IMF below the pectoralis major origin in the cadaveric group at the medial, midclavicular, and lateral locations was 1.9, 2.0, and 2.5 cm, respectively. The average distance of the IMF below the pectoralis major origin in the mastectomy patient group at the medial, midclavicular, and lateral locations was 1.5, 1.6, and 2.2 cm, respectively.

Conclusions: The IMF is inferior to the inferior origin of the pectoralis major muscle. Subpectoral dissection to the level of the IMF will disrupt the attachments of the pectoralis major muscle. (Aesthetic Surg J 2007;27:509–512.)

The inframammary fold (IMF) is a visual marker of the breast, and its importance for both aesthetic and reconstructive procedures is well accepted. The IMF determines the inferior border of the breast on the chest wall and defines ptosis. In addition, it provides inferior support for subpectoral implants that is essential to prevent migration.

Previous investigations of the IMF have focused on histologic study. Whereas some investigators have identified a well-defined ligament creating the fold, others have found no distinct structure. Proposed explanations for the IMF have included a condensation of the superficial fascial system, as well as an increase in dermal collagen. Clinically, we have noticed a constant relationship between the IMF and the inferior origin of the pectoralis major muscle that coincides with the embryologic development of the chest wall. The purpose of our study is to identify a relationship between the inferior origin of the pectoralis major muscle and the inframammary fold.

Materials and Methods

Cadaver study

Twenty female cadavers were examined. Ages ranged from 74 to 95 years. Inclusion criteria included surgically unaltered chest walls. Both sides of the chest were examined. The cutaneous inframammary fold was identified and then marked into the underlying chest wall with a 25-gauge needle dipped in methylene blue at three points along the fold: the midclavicular line, a parallel line 2 cm medial to the midclavicular line, and a parallel line 2 cm lateral to the midclavicular line (Figure 1). The skin and subcutaneous tissue were removed, exposing the chest wall musculature and the blue markings (Figure 2). The distances between the inferior origin of the pectoralis major muscle and the blue markings were measured by millimeter caliper (Table). A positive value was recorded if the pectoralis major origin was above the IMF. A negative value was recorded if the pectoralis major origin was above the IMF.
Patient study

After approval by the institutional review board, 10 female patients with breast cancer and with planned mastectomies were entered into the study. Ages of patients ranged from 42 to 61 years. The IMF was marked with the patient in the upright position with a skin-marking pen. With patients under general anesthesia, a 25-gauge needle dipped in methylene blue was introduced percutaneously along the IMF at the same three points used in the cadaver study (Figure 3). On completion of the mastectomy, the inferior origin of the pectoralis major and the blue markings were identified (Figure 4). The distances between the pectoralis major origin and the blue markings were measured. Standard deviations of measured values were determined by use of a function of Microsoft Excel (Microsoft, Redmond, WA).

Results

In both groups, the IMF was below the pectoralis major muscle origin for all measurements (Table). In the cadaveric group, the average distance between the pectoralis major and the IMF at the medial, midclavicular,

<table>
<thead>
<tr>
<th>Study group</th>
<th>Medial (cm)</th>
<th>Midclavicle (cm)</th>
<th>Lateral (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadavers (n = 40)</td>
<td>1.9 (1.5-2.6) SD, 0.29</td>
<td>2.0 (1.8-2.7) SD, 0.34</td>
<td>2.5 (2.0-3.4) SD, 0.32</td>
</tr>
<tr>
<td>Mastectomy patients (n = 10)</td>
<td>1.5 (0.8-1.8) SD, 0.27</td>
<td>1.6 (0.8-2.0) SD, 0.26</td>
<td>2.2 (1.6-2.8) SD, 0.27</td>
</tr>
</tbody>
</table>

SD, Standard of deviation.
and lateral points was 1.9, 2.0, and 2.5 cm, respectively.
In the mastectomy patient group, the average distance
between the pectoralis major and the IMF at the medial,
midclavicular, and lateral points was 1.5, 1.6, and 2.2
cm, respectively.

Discussion

The importance of the IMF as a landmark has under-
gone previous scrutiny. Past investigations have focused
on the cause and histologic makeup of the fold. With
Lockwood’s description\(^4\) of the superficial fascial system,
the IMF was explained as a zone of adherence. Bayati
and Seckel\(^1\) identified an “inframammary crease liga-
ment” that connected the ribs and intercostal muscle fas-
cia to the dermis. This connective tissue band was reli-
ably identified in their cadaveric dissections and was
thought to form the IMF. Boutros et al\(^2\) refuted the exis-
tence of this ligament in 1998. This group found no dis-
tinct connective tissue band along the fold. They did
identify a dense network of collagen along the dermis of
the IMF. They agreed with Lockwood and attributed the
fold to a condensation of the superficial fascial system.

Our study does not contribute to the active debate
over the histologic study of the IMF. We demonstrate
that the IMF is consistently inferior to the inferior origin
of the pectoralis major muscle. This anatomic associa-
tion has likely been observed clinically; however, no pre-
vious study has documented this relationship.

Awareness of the correlation between the position of
the IMF and pectoralis major muscle may impact clinical
practice in several ways. The conscious release of the
pectoralis major muscle is not considered routine in typi-
cal breast augmentation. Commonly, a subpectoral
pocket is developed that extends inferiorly to the IMF.
Division of the inferior origin of the pectoralis major
muscle is prescribed in dual-plane breast augmentation.\(^5\)
With this technique, the implant is covered superiorly by
muscle and inferiorly by only breast parenchyma.

Our findings indicate that the IMF is predictably infe-
rior to the inferior origin of the pectoralis major muscle.
Anatomy dictates that subpectoral dissection to the IMF
completely disrupts the inferior origin of the pectoralis
major muscle. We submit that all breast augmentations
that have subpectoral pockets developed to the IMF are
dual-plane augmentations and result in the release of the
pectoralis major muscle.

The relationship between the IMF and pectoralis
major muscle is also important with respect to breast
implant support. When performing subpectoral dissec-
tion to the level of the IMF, the surgeon should be aware
that any inferior support provided by the pectoralis
major muscle will be eliminated. This leaves the IMF as
the sole inferior support of the subpectoral implant. This
knowledge should cause the surgeon to be very judicious
in attempts to release the IMF and “lower the fold,”
because further elimination of inferior support could pre-
cipitate migration of the implant.

Another clinically relevant point is the evaluation of
the patient with a high IMF. This anatomic variation can
occur in women with a short IMF-to-nipple distance, in
the constricted breast, and in the tuberous breast. On the
basis of this preserved relationship of the IMF to the pec-
toralis major, the surgeon would recognize the foreshortened pectoralis major muscle and the more complex implications of submuscular implant placement.

We believe that the consistency of the relationship between the position of the IMF and the pectoralis major muscle is found in the embryologic study of the chest wall. The development of the breast and the pectoralis major muscle are clearly linked. Both structures form in the same dermatome distribution and share a common blood supply. Poland’s syndrome demonstrates how a single vascular event can impact these related structures. From this association, we infer that the relationship between the IMF and the pectoralis major muscle is forged in chest wall development, explaining the consistency of our anatomic observation.

**Conclusion**

The IMF is a vital chest wall landmark and supportive structure for both breast augmentation and breast reconstruction. Our study demonstrates that the IMF is predictably inferior to the inferior origin of the pectoralis major muscle. The better we understand the anatomy of the IMF, the more precise we can be in the planning and execution of our operations.

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**References**


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