Surgical Correction of Inverted Nipples

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Background: Nipple inversion is a common pathologic condition affecting 2%–10% of women. Congenital inversions are the most common forms, while acquired inversions are less frequent. This condition can induce psychological discomfort, functional problems that could prevent adequate breastfeeding, and cosmetic dissatisfaction, and create local irritation and infection. The aim of this article was to provide a comprehensive review of the literature about surgical treatment of inverted nipple.

Methods: A literature search was conducted by using PubMed, Google Scholar, and Cochrane database using the following MeSH terms: “inverted nipple,” “inverted nipple surgery,” “inverted nipple treatment,” and “inverted nipple management.” Studies that described surgical treatment and included outcomes and recurrence rate were included.

Results: Thirty-three articles were considered suitable, including 3369 inverted nipple cases. Eight studies described techniques with lactiferous ducts damaging, while 25 studies described techniques with lactiferous duct preservation using dermal flaps, sutures, or distractor systems. The average follow-up was 23.9 months. Overall, a satisfactory correction was reached in 88.6% of cases, and the recurrence rate was 3.89%.

Conclusions: To our knowledge, our review includes the largest sample size in the literature. The heterogeneity and subjectivity of outcomes make it more complicated to state which is the best surgical strategy to adopt to obtain satisfactory and stable results with minimal morbidity. This study highlights the need of a standardized method to evaluate outcomes, including aesthetic, functional and psychological results, while using objective and subjective measurement instruments.

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INTRODUCTION

Nipple inversion was first described by Cooper in 1840 and is defined as a nonprojecting nipple that lies below the plane of the areola. It affects 2%–10% of women. This frequent pathologic condition can be congenital or acquired, unilateral or bilateral, and it can present different degrees of severity. Congenital inversions are the most common forms, and they depend on hypoplasia and the retraction of the lactiferous ducts produced by the presence of surrounding fibrous bands at the base of the nipple. Acquired inversions can be secondary to mammary carcinoma, periductal mastitis, breast surgery, or breastfeeding.

The universally accepted classification of inverted nipple was proposed by Han and Hong, and they classified the inversion into 3 grades:

- Grade I: the nipple can be easily pulled out by gentle palpation around the areola and maintains its projection quite well without any traction. Lactiferous ducts are normal.
- Grade II: the nipple is also pulled out by palpation but not as easily as in grade I and tends to retract. The nipple has medium fibrosis, and the lactiferous ducts are mildly retracted but do not need to be cut to release the fibrosis. Also, there are histologically rich collagenous stromata with several bundles of smooth muscle.

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- Grade III: severe form in which inversion and retraction are important. Pulling the nipple out manually is really difficult, and a traction suture is needed to keep it protruded. Fibrosis beneath the nipple is severe and the soft tissue is insufficient. Histologically, the terminal lactiferous ducts and lobular units are atrophic and replaced with severe fibrosis.

Another classification proposed by Schwager et al divides inverted nipples into 2 forms depending on the severity of the inversion: an “umbilicated” form (intermittently inverted) and an “invaginated” form (permanently inverted). Inverted nipple can induce psychological problems such as severe psychosexual discomfort. Moreover, this condition can cause cosmetic and functional problems that prevent adequate breast feeding and can create local irritation and infection.

Generally, the nipple and areola can present in different size, color, and shape. The average height and diameter of the nipple are both about 1 cm, and the average diameter of the areola is about 3 cm. Five normal shapes of nipples were identified: rectangular, omega, round, cup, and slanting.

Since 1879, when Kehrer described the first surgical correction of nipple inversion, many surgical and nonsurgical corrective strategies have been proposed. Indeed, there is not a single technique adapted to all types of inverted nipples because of the heterogeneity of the clinical presentation. Ideally, the aim of every treatment should be to permanently recover normal projection and shape; to maintain a normal sensitivity; and finally to preserve the lactiferous ducts causing minimal scars. Nonoperative strategies, including manual traction, piercing, and vacuum therapy, can be used only in grade I inversion. The aim of this article was to provide a comprehensive review of the literature about surgical treatment of inverted nipples.

MATERIALS AND METHODS

A literature search was performed by using PubMed, Google Scholar, and Cochrane database according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines to provide a comprehensive review of the literature about surgical treatment of inverted nipples.

The following MeSH terms were used: “inverted nipple,” “inverted nipple surgery,” “inverted nipple treatment,” and “inverted nipple management” (period: 1999–2020; last search on 22 March 2020). Two different reviewers performed double screening and data extraction. Abstracts were examined to identify qualified papers. Reference lists of relevant articles were screened for supplementary studies. A flowchart based on PRISMA guidelines is shown in Figure 1.

Inclusion and Exclusion Criteria

Articles were selected based on the following inclusion criteria: (1) Studies investigating surgical treatment of inverted nipples; (2) registration of outcomes after surgical treatment; (3) registration of recurrence rate after surgical treatment; and (4) full text availability in English.

The studies were excluded due to any one of the following criteria: (1) Articles reporting only on surgical technique and not surgical outcomes; (2) articles including <10 nipples; (3) <6 months follow-up; (4) review articles; (5) case report; (6) nonreferenced articles; and (7) expert opinion or comment (Level V).

Data Collection

Extracted data included author names, years of publication, number of nipples included, sex, mean age, etiology of nipple inversion, affected side (one or bilateral), Han-Hong grading; surgical strategy (lactiferous ducts damaging or preservation), mean follow-up time, results (correction rate, nipple projection, nipple shape, and quality of scar), recurrence rate, nipple sensitivity, breast feeding, and postoperative complications.

Statistical Analysis

Statistical analysis was performed using SPSS statistical software (version 24.0; IBM Corporation, Somers, N.Y.).

RESULTS

One hundred and nine articles were identified after excluding duplicates. Two different authors screened all the records through titles and abstracts. Sixty full-text articles were examined for eligibility. Thirty-three articles were considered suitable based on relevance, appropriateness, and actuality and were included in this systematic review (Fig. 1).

Among the 33 selected studies, 17 were retrospective studies, 16 were prospective studies, of which one was a randomized controlled trial. A total of 3369 inverted nipples were included in the review, and the sample size of each study ranged from 14 to 562 nipples. Nineteen of 35 articles reported the etiology of the nipple inversion including 794 nipples: in 93.9% of the cases, the inversion was congenital, and in 6.1% of the cases, the inversion...
was acquired. The acquired etiology has been referred to periductal mastitis, breast cancer, or previous mammoplasty. Regarding the laterality of the inversion, 16 articles described patients affected by bilateral nipple inversion (642 patients): of these patients, 66.97% were affected on both sides (450/642 patients). Seven studies included recurrence, amounting to 22 patients.

All the patients were women except 2. Twenty-four studies reported patients’ age expressed as mean or range or as both mean and range. The mean age of patients was 29.5 years (range 16–75).

Grading

Twenty-four studies reported a preoperative grading according to Han-Hong. Among them, 349 nipples were classified as grade I, 838 nipples were classified as grade II, and 562 nipples were classified as grade III. One study reported the classification proposed by Schwager et al.7

Surgical Strategies

Concerning surgical strategies, 4 studies described techniques with lactiferous ducts damaging (Table 1,15,18,25,31), 25 described techniques with lactiferous ducts preservation and 4 studies included both (Table 2,15,16,31) (Fig. 2).

Surgical approaches without breastfeeding preservation are based on the section of the lactiferous ducts and the stabilization of the nipple’s eversion using Z-plasties and/or internal stitches (vertical suture, 5-point star suture, loop stitches with an arabesque-like shape) (Fig. 3).

Techniques with breastfeeding conservation are based on the careful dissection of the fibrous bands by the lactiferous ducts, which therefore remain completely or partially preserved. Techniques with lactiferous ducts preservation were divided into 3 subcategories based on the use of dermal flaps, sutures, or distractor systems. Fifteen studies described the use of dermal flaps (Table 3,5,8,9,11,14,17,21,24,26,28,30,32,54,35,40) with triangular, rhomboid, longitudinal, elliptical, or “diamond” shapes (Fig. 3). Six studies described several types of sutures (Table 4,19,25,36–38), including peripheral circular stitches on the base of the nipple or internal sutures (vertical suture, 5-point star suture, loop stitches with an arabesque-like shape) (Fig. 3).

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One author described the endoscopic technique with a dermal flap graft transfer from the groin to fill the base of the nipple.25 Two authors reported the use of magnification to better visualize and dissect lactiferous ducts.22,66

Eleven authors explicitly described the placement of a temporary traction (3–30 days)31,33,34,41 or a “donut” dressing to avoid a postoperative compression (2 weeks–6 months).14,15,21,24,29,25

Outcomes

Mean follow up was 23.9 months (range, 3–192 months). In most articles, results were expressed as the rate of satisfactory correction, which ranges between 64% and 100% (average, 88.7%). Nineteen studies reported that in 100% of the cases, the correction was effective and permanent.

Five studies evaluated nipple projection reporting:

- An average projection loss of 31.4%, 31.8%, and 39% one year after surgery, respectively, in grade II, grade III, and in acquired forms.36
- Maintenance of nipple projection at 93%–100% of the nipple height achieved at the time of the operation (9.8 ± 0.9 mm, which had decreased to 8.0 ± 1.0 mm one year after surgery).37

Eleven studies utterly reported the quality of the scars referred as minimal in all cases except for 8 nipples.

Registration of recurrence rate was reported in all the studies being one of the inclusion criteria and resulted pair to 3.89% (131 nipples/3369) in this review. Recurrence rate was reported between 0% and 34.1%.

Satisfactory outcomes rate and recurrence rate in techniques that included lactiferous ducts damaging (91 nipples) were, respectively, 96.7% and 3.3%. Satisfactory outcomes rate and recurrence rate in techniques with lactiferous ducts preservation using dermal flaps (1594 nipples) were, respectively, 97.6% and 1.5%. Satisfactory outcomes rate and recurrence rate in techniques with lactiferous ducts preservation using corrective sutures (247 nipples) were, respectively, 90.6% and 6%. Satisfactory outcomes rate and recurrence rate in techniques with lactiferous ducts preservation using distractor systems (317 nipples) were, respectively, 98.4% and 1.5% (Table 4).

Sensitivity and Breastfeeding

Twenty-three articles reported data on postoperative nipple sensitivity. Sensitivity was evaluated using the brush test in 3 articles,11,37,36 an analog scale considering light touch and 2-point discrimination analysis in 2 articles,20,22 and a specific questionnaire22 or a questionnaire combined with a cotton test in 2 articles.13,39 In the other studies, the outcome measurement method was not specified.

In 20 studies, nipple sensitivity results were normal in all patients, whereas in 3 studies, the nipple sensitivity results were temporarily or permanently altered (8 nipples).

Thirteen studies reported breastfeeding outcomes with good results in a small number of patients.

Postoperative Complications

Thirty-three studies mentioned postoperative complications, including 2885 nipples. Complication rate resulted in 1.7% (49/2885 nipples) of cases, and the most frequent problems were nipple sloughing (10 cases), areolar ulcer (8 cases), obvious scars (8 cases), superficial infection (7 cases), partial necrosis (3 cases), depigmentation (2 cases), wound dehiscence (2 cases), wire dislocation in case of retractor (2 cases), nipple necrosis (1 case), nipple insensitivity (1 case), stitch abscess (1 case), hematoma (1 case), and epidermal cyst (1 case).

DISCUSSION

Nipple inversion represents a common pathological condition with aesthetic, functional, and psychological consequences. To our knowledge, our review includes the largest sample in literature, analyzing 3369 inverted nipples.
Table 1. Surgical Techniques with Lactiferous Ducts Damaging

| Author/Year          | Type                  | Sample Size | Grading          | Surgical Technique                                                                                                                                                                                                 | Follow-up | Results                                      | Recurrence Rate | Nipple Sensitivity | Breastfeeding (BF) | Postoperative Complications |
|----------------------|-----------------------|-------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------------------------------|------------------|-------------------|---------------------|------------------------|
| Lee et al/2003       | Prospective analysis  | 17 nps      | Grade I: 0       | Inferior periareolar incision (5–7 o’clock)                                                                                                                                                                                                                           | 12 m      | 100% satisfactory correction               | 0                | Not reported      | Not reported         | Not reported           |
|                      |                       |             | Grade II: 0      | Two internal vertical sutures                                                                                                                                                                                                                                     |           | 100% patients satisfaction                 |                  |                   |                     |                       |
|                      |                       |             | Grade III: 17    | Without the use of dermal flaps                                                                                                                                                                                                                                   |           | With the use of dermal flaps              |                  |                   |                     |                       |
|                      |                       |             |                  | Postoperative stent for 3 m                                                                                                                                                                                                                                        |           | 100% patients satisfaction                 |                  | 0                 |                     |                       |
|                      |                       |             |                  |                                                                                                                                                                                                                                                                    |           | 0                                           | 100% patients satisfaction |                  |                     |                       |
| Serra-Renom et al/2004 | Retrospective analysis | 12 pts      | —                | Surgeries with small periareolar incision (5–7 o’clock) Section erector muscle and lactiferous canaliculi 5-point star stitches                                                                                                                                      | 12 m      | 100% satisfactory correction               | 0                | Not reported      | Not possible         | No major complications |
|                      |                       | Mean age 24 y (18–46) |                  |                                                                                                                                                                                                                                                                    |           | 0                                           | 100% patients satisfaction |                  |                     |                       |
| Sapountzis et al/2011 | Prospective analysis  | 18 pts      | Grade III        | 4 microincisions of about 0.5 cm at 12–3–6–9 o’clock                                                                                                                                                                                                             | 3–12 m    | 91% satisfactory outcome                  | 2 nps            | Normal            | Not possible         | No major complications |
|                      |                       | 22 nps      |                  |                                                                                                                                                                                                                                                                    |           | 91% satisfactory outcome                  | 2 nps            | Normal            | Not possible         | No major complications |
|                      |                       | Mean age 26 y (20–37) |                  | Erector muscle and lactiferous ducts dissected and sectioned Loop stitch with an arabesque-like shape (between 3–9 and 6–12 o’clock) Donut dressing 1 w                                                                                                                                 |           | 91% satisfactory outcome                  | 2 nps            | Normal            | Not possible         | No major complications |
| Bracaglia et al/2012 | Retrospective analysis | 19 pts      | Grade I: 0       | Periareolar incision in the lower quadrants Ducts and the fibrous tissue section                                                                                                                                                                                     | 26 m (6 m–3 y) | 97% satisfactory correction               | 1 case (3%)     | One patient developed a temporary loss of sensibility | Not possible         | No major complications |
|                      |                       | 35 nps      | Grade II: 0      | Ducts and the fibrous tissue section                                                                                                                                                                                                                               |           | 97% patients satisfaction                 | 1 case (3%)     | One patient developed a temporary loss of sensibility | Not possible         | No major complications |
|                      |                       | All congenital | Grade III: 20 (+15 relapse) | Dermoglandular monolobed flap overturned under the nipple to fill the “dead space” No protective devices                                                                                                                                                      |           | 97% patients satisfaction (shape and projection) | 1 case (3%)     | One patient developed a temporary loss of sensibility | Not possible         | No major complications |
|                      |                       | Mean age 36 y (25–46) |                  | Minimal scars                                                                                                                                                                                              |           | 97% patients satisfaction (shape and projection) | 1 case (3%)     | One patient developed a temporary loss of sensibility | Not possible         | No major complications |
Table 2. Surgical Techniques with Lactiferous Ducts Damaging or Preservation

| Author/Year | Type            | Sample Size | Grading  | Surgical Technique                                                                 | Follow-up | Results                          | Recurrence Rate | Nipple Sensitivity | Breastfeeding (BF) | Postoperative Complications |
|-------------|-----------------|-------------|----------|------------------------------------------------------------------------------------|-----------|---------------------------------|----------------|-------------------|---------------------|--------------------------|
| Han and Hong/1999 | Retrospective analysis | 60 pts, 107 nps | Grade I: 14 | BF preservation
Grade I: Nonincisional + purse-string suture
Grade II: Release of fibrosis + purse-string suture
No BF preservation
Grade III: Release of fibrosis
+cutting of ducts +dermal flaps + purse-string suture | — | 97.2% satisfactory correction | 2.8% (3 nps) | Not reported | Not reported | 1 hematoma; 3 sloughing; No infection |
| Sakai et al/1999 | Retrospective analysis | 148 pts, 255 nps | Grade I: 23 | Method I: 172 nps
No BF preservation: Vertical incision into the nipple, contracted tissue excision, Z-plasties on the neck of the nipple | — | Method I: 163 94.7% excellent results | 8 nps | Method I = 5 recurrence | Method II: 3 recurrence | Not reported | 24 nps (12 pts) | 4 partial necrosis |
| Lee and Cho/2004 | 11 pts | — | Modified Namba technique
Modified Namba technique | 19.6 m (range 6–54) | Modified Namba technique | 2 nps recurrence | 9 nps | 69.2% satisfactory outcomes | Not reported | No major complications |
| Kalaaji et al/2019 | Retrospective analysis | 86 pts, 161 nps, 87% bilat Mean age 28.7 y (18–61) | Grade I: 16
Grade II: 56
Grade III: 89 | 4 Techniques
1. Central tunnelization of the retracted fibers/ducts (39 pts, 45%)
2. Partial incision of the center of the inversion through a tunnel (31 pts, 36%)
3. Total cut of the lactiferous ducts (16 pts, 19%)
4. Fat grafting as support in 14 patients (26 nipples)
Postoperatively, nipples were suspended for 4 weeks using a manually reconstructed device | 14 m (2–57) | Patient satisfaction: 43 of 71 cases (61%) after the first operation
23 patients (93%) after the second operation,
3 patients after the third operation (97%).
2 patients were not satisfied and 15 patients were not available for follow-up | 32 pts–55 nps after the first operation (6 pts–nps after the second operation, in 1 pt after the third operation) | Not reported | Not reported | 4 local infection; 2 local irritation |
Almost 70% of cases resulted were affected by a bilateral condition. More than 90% of patients were affected by a congenital nipple inversion, while the acquired etiology was less frequent, representing only 6.1% of cases. Periductal mastitis, breast cancer, or previous mammoplasties were the most common causes.

Twenty-four studies reported a preoperative grading according to Han-Hong. The Han and Hong grading is the most recent and widespread inverted nipples classification system. This is based on the subjective quantification of the amount of effort required to allow an eversion of the nipple.

The pathogenesis of the congenital nipple inversion was recently clarified and seems to depend by the shortness of lactiferous ducts, the lack of supporting tissues, and the presence of fibrous bands that cause retraction at the base of the nipple. Consequently, the different therapeutic strategies are all based on common cardinal assumptions: the dissection or the resection of the fibrous bands and the lactiferous ducts, the increase of volume below the nipple or the filling of the dead space created by the resection, and the tightening of the neck of the nipple.

In the current review, 4 studies described techniques with lactiferous ducts damaging, 25 studies described...
| Author/Year        | Type                   | Sample Size | Grading        | Surgical Technique                    | Follow-up | Results                          | Recurrence Rate | Nipple Sensitivity | Breastfeeding (BF) | Postoperative Complications |
|-------------------|------------------------|-------------|----------------|---------------------------------------|-----------|----------------------------------|-----------------|-------------------|---------------------|-------------------------|
| Crestinu/2000     | Retrospective analysis | 452 nps     | —              | Umbrella musculocutaneous flap        | 60 m      | 99.8% satisfactory correction    | 1 nps (0.2%)    | Normal            | Normal after 2-3 y   | Not reported            |
| Huang/2003        | Retrospective analysis | 25 pts, 46 nps | —              | Three diamond-shaped inferorly based dermofibrous flaps “Donut” dressing | 6-60 m    | 100% satisfactory correction     | 0               | Not reported       | Not reported         | 5 nps sloughing of partial skin No major complications |
| Kim et al/2003    | Prospective analysis   | 11 pts, 16 nps, Mean age: 27 (18-31) All congenital | Grade I: 0, Grade II: 13, Grade III: 9 | Two triangular areolar dermal flaps | 8.7 m (range, 3-12) | 100% satisfactory correction | 0               | Normal            | Not reported         | No major complications |
| Ritz et al/2004   | Prospective analysis   | 11 pts, 18 nps, Mean age 31 y | —              | Two dermofibrous longitudinal flaps    | 27 m      | 100% satisfactory correction     | 0               | Normal            | Not reported         | No major complications |
| Kim et al/2006    | Prospective analysis   | 15 pts, 29 nps, Mean age: 26 y (21-55) All congenital | 21 pts, umbilicated type 8 nps imagined type | Three diamond patterns, set at 120-degree intervals | 14 m      | 100% satisfactory correction     | 0               | 1 pt, 2 nps (Grade III) | Reduced but possible (3 pts) Normal (5 pts) | No major complications |
| Kim et al/2006    | Prospective analysis   | 17 pts, 28 nps, Age range: 21-29 26 congenital 2 acquired (mastitis) | Grade I: 0, Grade II: 19, Grade III: 9 | Two-four diamond-shaped quadrangles Donut-type pad dressing for 2-3 m postoperatively | 6.3 m (3-8) | 96.5% satisfactory correction    | 3.5%            | Normal (no permanent numbness) | Not reported         | No major complications |
| Wu et al/2008     | Prospective analysis   | 9 pts, 14 nps, Mean age: 23 y (19-36) 13 congenital 1 recurred 46 pts, 87 nps (41 balat) | Grade I: 0, Grade II: 34, Grade III: 34 | Two triangular areolar dermofibrous flaps “Donut” dressing Continuous traction 2 weeks | 3-18 m     | 100% patients satisfaction Nipples are relatively symmetric | 0              | No permanent sensory disturbance | Not reported         | No major complications |
| Min et al/2009    | Prospective analysis   | 20 pts, 35 nps, Mean age: 35 y (16-48) 34 congenital 1 acquired (mastitis) 2 recurred | Grade I: 0, Grade II: 35, Grade III: 35 | Triangular dermal flaps under the areolar skin (scar-free) Traction sutures for 3 days | 3-12 m     | 100% patients satisfaction       | 0              | Not reported       | 2 hypopigmentation over the areola with areolar flaps (resolved spontaneously) |
| McG Taylor et al/2011 | Retrospective analysis | 20 pts, 35 nps, Mean age: 35 y (16-48) 34 congenital 1 acquired (mastitis) 2 recurred | Grade I: 0, Grade II: 35, Grade III: 35 | 2 Areola-based dermoglandular rhomboid flaps at 6 and 12 o’clock Medical translation of the 2 flaps No special or bulky dressing | 1-16 y (32 nps) | 15 nps maintained complete eversion Early postoperatively (3 m follow-up) | 5 nps postoperatively | On specific questioning, no patients reported a reduction to nipple sensation following surgery | Normal (3 pts 4: 10-16 y post surgery) | 3 superficial infection treated with oral antibiotics |

(Continued)
### Table 3. (Continued)

| Study                  | Type of Study     | Study Design | Procedures                                                                 | Patients and surgeon were asked to score nipple cosmetic outcome and their own satisfaction | Results were good considering projection, shape, and sensitivity | Nipple projection and shape postoperatively                      | Number of patients | Cosmetic Outcome | Satisfaction | Complications                  |
|------------------------|-------------------|--------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|--------------------|-----------------|----------------|-----------------------------|
| Persichetti et al/2011 | Retrospective     | Analysis     | Vertical incision in the middle of the nipple, extended below the areola plane as deep as necessary to completely release the retracted ducts (interruption of central lactiferous ducts) | 1–6 y                                                                                           | Minimal scar                                                    | 52 pts Grade I: 16 Grade II: 20                                      | 3/5 normal         | 1 nps Preserved         | 1 y (successfully treated with a second procedure) | 2 wound dehiscence                  |
| Zhou et al/2011        | Prospective       | Analysis     | 15–21 days rhomboid dermal flaps (pedicle located on the nipple base)       | 6 m–3 y (29 pts)                                                                                   | 100% satisfactory correction                                    | 36 pts Grade I: 8 (pts) Grade II: 19 (pts) Grade III: 9 (pts)       | 1 normal           | 49 nps 1 partial scarring | 100% satisfactory correction | Among the 13 patients 12 normal |
| Taneda et al/2013      | Retrospective     | Analysis     | Sakai technique                                                             | 6–50 m                                                                                           | 100% satisfactory outcomes                                     | 379 pts — Sakai technique 6–50 m                                    | 1 normal           | Not reported          | 100% satisfactory outcomes | No major complications                     |
| Durgun et al/2014      | Retrospective     | Analysis     | 2 triangular dermal flaps                                                   | 16.5 m (8–24)                                                                                     | 100% patients satisfaction                                      | 16 pts Grade II or III Traction 3 weeks                             | 1 normal           | Normal            | Slight changes in the results: Omega to round shape in 3 cases Omega to cup shape in 1 case Omega to slanting shape in 1 case | No major complications                     |
Table 3. (Continued)

| Study            | Technique                      | Group A                          | Group B                          | Group C                          |
|------------------|--------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Li /2016         | (traditional technique):       | 25 pts                           | 41 nps                           | 60 pts                           |
|                  | 25 pts                         | 64% satisfaction                 | 95% satisfaction                 | 100% satisfactory                |
|                  | 25 pts                         | (6–12)                           | (6–12)                           | outcomes                         |
|                  | 25 pts                         | 3 periducal dermofibrous flaps    | 0 Nipple sensation                | 0 pt stitch abscess              |
|                  | according to the Huang technique |                                 | 0 Nipple sensation                | 1 pt epidermal cyst              |
|                  |                                 | 3 periducal dermofibrous flaps    | 0 Nipple sensation                | 0 Nipple sensation                |
| Mathur et al/2018 | (traction device):             | 49 pts                           | 74 nps                           | 1% stitch abscess                |
|                  |                                 | Grade I: 9                       | Grade II: 16                     | 1% stitch abscess                |
|                  |                                 | Grade III: 23                    | Grade III: 34                    | 1% stitch abscess                |
|                  |                                 | Age range: 10–18                 | Age range: 16–46                 | 1% stitch abscess                |
|                  |                                 | Grade I: 16                      | Grade I: 34                      | 1% stitch abscess                |
|                  |                                 | Grade III: 24                    | Grade III: 34                    | 1% stitch abscess                |
|                  |                                 | Age range: 10–18                 | Age range: 16–46                 | 1% stitch abscess                |
|                  |                                 | 6–12 o'clock                     | 6–12 o'clock                     | 1% stitch abscess                |
|                  |                                 | Traction 2–4 m                   | Traction 2–4 m                   | 1% stitch abscess                |
|                  |                                 | 6 insensitivity                  | 5 recurrence                     | 6 insensitivity                  |
|                  |                                 |                                     | 1 nipple necrosis                | 6 insensitivity                  |
|                  |                                 |                                     |                                  | Group A                           |
|                  |                                 |                                     |                                  | 6 obvious scar                   |
|                  |                                 |                                     |                                  | 1 nipple necrosis                 |
|                  |                                 |                                     |                                  | 6 insensitivity                  |
|                  |                                 |                                     |                                  | Group B                           |
|                  |                                 |                                     |                                  | 1 wire                            |

**Drawbridge** Flap
- Vertical ellipse along the height of the nipple-areola at 6 o'clock position
- Nipple component of the ellipse incision to raise a dermal flap from the tip of the nipple down to its base and lowered down in the manner of a drawbridge
- Lactiferous ducts which are selectively divided under loupe magnification
- Dermal "drawbridge" flap interposition between the lactiferous ducts and sutured to the opposing side

- Nipple sensation was preserved in 100% of cases
- Lactation, although possible, was not reported in the duration of this study
Table 4. Surgical Techniques with Lactiferous Ducts Preservation: Sutures

| Author/Year | Type               | Sample Size    | Grading          | Surgical Technique                                | Follow-up | Results                  | Recurrence Rates | Nipple Sensitivity | Breastfeeding | Postoperative Complications |
|-------------|--------------------|----------------|------------------|--------------------------------------------------|-----------|-------------------------|------------------|-------------------|---------------|-------------------------|
| Steven et al/2004 | Retrospective analysis | 21 pts (38 nps, 2 pts recurrence after surgery) | —                | Inferior periareolar incision                      | 12 m      | High patients satisfaction | 0               | Not reported        | Not reported |                         |
|             |                    |                |                  | Vertical spread preserving the ducts              |           |                         |                  |                   |               |                         |
|             |                    |                |                  | 2 internal sutures (deep dermis to deep dermis) drawing together the opposite walls of the nipple, providing further stability + purse-string suture |           |                         |                  |                   |               |                         |
|             |                    |                |                  | Traction maintained for 2–5 days                  |           |                         |                  |                   |               |                         |
|             |                    |                |                  | Minimally invasive                                |           |                         |                  |                   |               |                         |
| Kolker et al/2009 | Retrospective analysis | 31 pts (58 nps, 27 bilateral) | Grade I: 18 Grade II: 30 Grade III: 10 | 18-gauge needle is inserted at the 6 o’clock position, using the tip to lyse the foreshortened subareolar fibro-ductal tissue | 22 m (8-49) | 78% satisfactory correction (first procedure) | 13/38 occurring between 3 days and 17 weeks | Not reported | Not reported | No major complications |
|             |                    |                |                  | Purse-string suture                               |           |                         |                  |                   |               |                         |
|             |                    |                |                  | Two crossed 5-0 plain gut mattress sutures        |           |                         |                  |                   |               |                         |
| Shiau et al/2011 | Prospective analysis | 17 pts (23 nps, Mean age 30 (18–51) All congenital, 2 recurred) | Grade I: 0 Grade II–III: 23 | Telescope method                                  | 11.4 m    | 78% satisfactory correction | 0               | Questionnaire + Cotton-swab brush test | 3 pts normal breastfeeding | 1 case of minor skin necrosis at the distal suture site of the wedge resection |
|             |                    |                |                  | One circular incision                             |           |                         |                  |                   |               |                         |
|             |                    |                |                  | Dissection underneath the breast tissue through a reverse cone shape  |           |                         |                  |                   |               |                         |
|             |                    |                |                  | Two small triangular wedge resections of the areolar skin at the 3 and 9 o’clock positions Three sutures between the deep stalk and outer subareolar breast tissue  |           |                         |                  |                   |               |                         |
|             |                    |                |                  | Purse-string suture                               |           |                         |                  |                   |               |                         |
| Jeong et al/2017 | Prospective analysis | 46 pts (75 nps, 29 bilateral) | [Congenital = 63 nps, Grade I: 0 Grade II: 35 Grade III: 28] | Simultaneous augmentation mammoplasty in 9 pts BF preservation  | 22.4 m (32 pts) | 1. Nipple projection (mm) and determination of projection loss (%) at 1 y. Mean projection loss Congenital Grade II: 31.4% | 0               | Normal             | Not reported | 2 cases of mild epidermolysis (wound healed with secondary intention, and there were no sequelae) |
|             |                    |                |                  | 3 slit incisions at 3, 9, and 12 o’clock Double-track sun-cross running suture |           |                         |                  |                   |               |                         |

(Continued)
| Study          | Methodology      | Subjects | Grade | Technique Description                                                                 | Follow-up | Complications |
|---------------|------------------|----------|-------|---------------------------------------------------------------------------------------|-----------|---------------|
| Liang et al/2017 | Prospective      | 30 pts   | Grade I: 24 |
|               |                  |          | Grade III: 15 | Cut the fibrous tissue under the nipple (scissor tips were directed downward to the center → duct preservation) | 6–12 m    | 2 pts (4 nps) |
|               |                  | 55 nps   |       | 4 microincisions 3, 6, 9, 12 o’clock                                                  |           |               |
|               |                  | 25 bilat |       | Mean age 27 (22–32)                                                                  |           |               |
|               |                  |          |       | 2 pts (4 nps) recurrence                                                              |           |               |
|               |                  |          | Grade II: 16 |                                                                                      |           |               |
|               |                  |          |       | Brush test revealed that all postoperative nipples retained sufficient sensory function to elicit a contraction response |           |               |
|               |                  |          |       | Normal breastfeeding                                                                 |           |               |
|               |                  |          |       | No major complications                                                                |           |               |
| Dessena et al/2018 | Retrospective     | 32 pts   | Grade I: 0 | Poliglecaprone spacer | 12 m | 0 |
|               |                  |          | Grade II-III: 41 | Minimal incision (2–3 mm) at the 6 o’clock | | Not reported |
|               |                  |          |       | Purse-string, closed with several knots to make a long “rope” of poliglecaprone suture. The “rope” is used as an absorbable filler | | Not reported |
|               |                  |          |       | 100% patients satisfaction                                                             |           | 1 case partial necrosis in a patient who underwent tumorectomy and radiotherapy |
techniques with lactiferous ducts preservation, and 4 studies included both. Among studies describing techniques for lactiferous ducts preservation, different types of dermal flaps, sutures, or distractor system were used. For what postoperative management is concerned, 11 authors explicitly described the placement of a temporary traction (3–30 days) or a “donut” dressing to avoid compression (2 weeks–6 months) in postoperative.

Fig. 4. Techniques with lactiferous ducts preservation: “dermal flaps.”

Fig. 5. Techniques with lactiferous ducts preservation: “sutures.”
### Table 5. Surgical Techniques with Lactiferous Ducts Preservation: Distractors

| Author/Year       | Type               | Sample Size | Grading | Surgical Technique                  | Follow-up          | Results                                          | Recurrence Rate | Nipple Sensitivity | Breastfeeding (BF) | Postoperative Complications |
|-------------------|--------------------|-------------|---------|-------------------------------------|--------------------|-------------------------------------------------|-----------------|---------------------|---------------------|-------------------------|
| Teng et al /2005  | Prospective analysis | 14 pts     | Grade I: 6 | Continuous elastic outside distraction | 7.3 m (range, 3–12) | 100% satisfactory correction                     | 0               | Analog scale using light touch and 2-point discrimination analysis | Not reported       | No major complications |
|                   |                    | Grade II: 9 | 3–6 m for consolidation               |                    | 100% patients satisfaction                    |                  |                     |                     |                         |
|                   |                    | Grade III: 11|         |                                     |                    | Complete symmetry of the nipple–areola complex with no noticeable scars | 0               |                     |                     |                         |
|                   |                    |             |         |                                     |                    |                                                 |                  |                     |                     |                         |
| Caviggioli et al /2008 | Prospective analysis | 28 nps    | Grade I: 0 | Pitanguy's technique (release of the fibrous tissue between the ducts with a direct approach) | 12 m                | None of the patients suffered permanent paresthesia | 0               |                     |                     |                         |
|                   |                    | Grade II: 28|         |                                     |                    |                                                 |                  |                     |                     |                         |
|                   |                    | Grade III: 0|         |                                     |                    |                                                 |                  |                     |                     |                         |
| Long et al /2011   | Prospective analysis | 53 pts     | Grade I: 0 | Retractor 10-ml (or 5-ml) syringe 6 m | 11.9 m (range, 8–18) | 100% patient satisfaction                       | 0               |                     |                     |                         |
|                   |                    | Grade II: 75|         |                                     |                    |                                                 |                  |                     |                     |                         |
|                   |                    | Grade III: 0|         |                                     |                    |                                                 |                  |                     |                     |                         |
| Feng et al /2019   | Randomized controlled trial | 230 pts who will breastfeed 391 nps | Grade I: 196 | Distracter was made using the distal end of a 10-ml syringe 6 m | 19.5 m (8–55) | None of the patients suffered permanent paresthesia | 0               |                     |                     |                         |
|                   |                    | Grade II: 195|         |                                     |                    |                                                 |                  |                     |                     |                         |
|                   |                    | Grade III: 0|         |                                     |                    |                                                 |                  |                     |                     |                         |
|                   |                    | Distractor group: 168 nps |         |                                     |                    |                                                 |                  |                     |                     |                         |
|                   |                    | Control group: 152 nps |         |                                     |                    |                                                 |                  |                     |                     |                         |

1. Aesthetic results evaluated by surgeons: good in 165/168 nps in the distractor group (98%).
2. Aesthetic results evaluated by pts by questionnaire:163 of 168 nps in the distractor group (97%).
3. Grade I and II nipples achieved increased height after the distractor was worn for 6 months and at 37 weeks of pregnancy, while the control nipples achieved only a marginal improvement at 37 weeks of pregnancy.

Partial in 5 Grade II nipple (2-3 m after distractor removal). However, the nipples had been converted from Grade II to Grade I.

Distractor group success rates 84.9% and 79.3% for Grade I and II nipples, respectively. Control group significantly lower (P<0.005) 52.5% and 38.9% for Grade I and II nipples, respectively.

Chapped nipples and mastitis was higher in the control nipples than in the distractor nipples P<0.05. 2 pts underwent a fistula excision after the breastfeeding period ended.

Women were taught exercises to loosen the adhesions of the nipple. The exercises had to be performed each morning for 6 m.
Each surgical approach has its own advantages and disadvantages. Regardless of their conformation, local flaps certainly consent the stabilization of the nipple projection supporting the base of the nipple without compromising breastfeeding. Nevertheless, flaps required relatively extended operative time, multiple incisions, and subsequent scars. Moreover, the risk of these techniques is to provoke a distortion of the nipple–areolar complex, prejudicing the final aesthetic outcome. However, in our review, the 97.5% of patients who underwent a correction using dermal flaps reached satisfactory aesthetic results and presented a low rate of recurrence (1.5%).

Corrective techniques based on sutures present the main advantage to reduce scars on the nipple–areolar complex skin. However, the suture offers a more precarious stability of nipple inversion when compared with flap’s placement. There are 2 different aims while performing sutures: tightening the neck of the nipple (purse-string su- tures) or both (double-track sun-cross running sutures). The attainment of the nipple neck’s tightening can be assisted also using Z-plasties or wedge excision of the nipple base.

These surgical approaches (flaps and sutures) are clearly always combined with lactiferous duct release using 1 or more incisions. Kalaaji et al. proposed a lactiferous duct release incision-free by the “central tunnel technique.” The latter consisted in the creation of a tunnel using a needle instead of a blade, the liberation of the lactiferous ducts of the central portion of the nipple, and the filler of the empty space with a fat graft.

Continual distraction represents a less invasive, safe, and easier technique that minimizes scars and reduces injury to the nipple–areolar complex. The rationale of the distraction is to create a constant exterior traction on the fibrous bands and the hypoplastic lactiferous ducts to stretch their relative adhesion points. At the same time, the traction stimulates the growth of granulation tissue that works as support of the nipple base. However, this technique needs a long-lasting treatment requiring a very high degree of patient’s compliance. Indeed, the distraction can cause a disruption in daily life activities. In our review, the recurrence rate in case of outside distraction was very low (1.5%). Nevertheless, the low percentage of inverted nipples grade III and the short follow-up of 1 of the 4 studies must be considered as confounding factors.

In most articles, results were expressed as the rate of satisfactory correction, which ranges between 64% and 100% (mean 88.6%). In our opinion, the absence of a standard outcome measurement evaluating aesthetic, functional, and psychological results is one of the critical points of nipple-inverted treatment. Concerning aesthetic and functional outcomes, an objectively satisfactory result should comprehend an appropriate and stable nipple projection, an appropriate and stable nipple shape, a preserved sensitivity, a preserved lactation, and presence of minimal scars. Another considerable parameter should regard patient’s self-evaluation and patient satisfaction. Even if the Breast Q, which is the most widespread method of measurement in breast surgery, contains a section dedicated to “nipple–areola complex”, to our knowledge, none of the published studies evaluated patient’s satisfaction using this specific questionnaire.

A study based on 600 nipple measurements in adult women described that the mean projection of a normal nipple is 0.9 cm. Only 4 studies reported an objective measurement and evaluation of stability of the nipple projection, showing in the first postoperative year different grades of projection decrease, which varies from 7% to 40%.

Kim et al identified 5 normal nipple shapes (rectangular, omega, round, cup, and slanting). However, only 2 studies explicitly mentioned outcomes about nipple shape referred to this classification.

Twenty-two articles reported data about postoperative nipple sensitivity. Sensory innervation of the nipple–areolar complex depends from a deep and a superficial plexus originating from the anterior cutaneous branches of the third, fourth, and fifth intercostal nerves and from branches of the lateral cutaneous nerves of the fourth and fifth intercostal nerves.

The sensitivity measurement method is not specified in most of the studies. The few articles that reported sensitivity outcomes measurement methods adopted the brush test, an analog scale considering light touch and 2-point discrimination analysis and a questionnaire. Only 3 studies reported a temporary or permanent alteration of nipple sensitivity (8 nipples). Twelve studies reported data about breastfeeding with relatively good results but considering a very little sample of patients.

Similarly, the quality of scar is not expressed through a specific assessment scale. However, in just 8 among the >2800 cases, obvious scars are reported. Recurrence rate was one of the inclusion criteria, and the results were totally equal to 3.89% (131 nipples/3369) ranging between 0% and 34.1%.

To sum up, satisfactory outcome rate was, respectively, 96.7%, 97.5%, 90.6%, and 98.4% in techniques with lactiferous ducts resection, in techniques with lactiferous ducts preservation using flaps, sutures, or distractor. Recurrence rate was 3.3%, 1.5%, 6%, and 1.5%, respectively, in techniques with lactiferous ducts resection, in techniques with lactiferous ducts preservation using flaps, sutures, or distractor. However, according to us, the differences in terms of sample size, preoperative grading, methods of outcomes measurement and follow-up time impede to draw any
CONCLUSIONS

According to our research, our review includes the largest sample size in literature, analyzing 3369 inverted nipples and offering a global analysis about preoperative evaluation, surgical strategies, and surgical outcomes in patients affected by nipple inversion. However, the heterogeneity and subjectivity of outcomes presentation make it more complicated to state which is the best surgical strategy to obtain satisfactory and stable results with minimal morbidity. This study highlights the need of a standardized method to evaluate outcomes, including aesthetic, functional, and psychological results using objective and subjective measurement instruments. Prospective studies with a standardized outcome measurement method will be essential to better understand which is the ideal corrective strategy for patients affected by different grades of nipple inversion.

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