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Long-term stability of limiting nasal alar base width changes with a cinch suture following Le Fort I osteotomy with submental intubation

R. Raithatha, F. B. Naini, S. Patel, M. Sherriff, H. Witherow
Maxillofacial Unit, St George's Hospital NHS Foundation Trust, London, UK

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Abstract. The aim of this study was to assess the effectiveness of the nasal alar base cinch suture following Le Fort I osteotomy at long-term follow-up. One hundred and forty participants (89 female, 51 male) aged between 16 and 51 years underwent Le Fort I osteotomy with submental intubation. Anthropometric measurements of the nose were taken intraoperatively, immediately postoperative, and for up to 3 years postoperative: the maximum lateral convexity of the alae (Al–Al) and the lateral extremity of the alar base curvature at the alar groove (Ac–Ac). The use of a cinch suture was recorded. The results were analysed using a linear mixed-effects model analysis. One hundred and six participants had cinch sutures and 34 had no cinch sutures. Following Le Fort I osteotomy, there were significant increases in Ac–Ac (by 4.29 mm) and Al–Al (by 3.70 mm) (both $P < 0.0001$). Cinch sutures significantly reduced the widths back to preoperative values ($P < 0.0001$). Alar width remained stable over 3 years, with an increase of 0.36 mm for Al–Al ($P > 0.05$) and 1.03 mm for Ac–Ac ($P < 0.05$) compared to the postoperative measurement. In conclusion, a cinch suture was helpful in reducing the unwanted alar base width changes, which were found to be relatively stable at 3 years.

Key words: Le Fort I osteotomy; cinch suture; nasal width; alar base width; stability.

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Facial aesthetics can be one of the most important factors for patients seeking orthognathic surgery; therefore both the oral and maxillofacial surgeon and the orthodontist need to plan for the final soft tissue morphology of the patient in relation to the planned skeletal movements. Whilst orthognathic treatment can achieve aesthetically pleasing results, the main area of concern can be the changes in the soft tissues with maxillary moves, in particular the appearance of the nose[1].

Soft tissue changes with Le Fort I osteotomy

Changes in the position of the jaws can lead to changes in the soft tissues of the lips, cheeks, and nose[1]. The changes in the lip include thinning, reduced vermillion show, and lack of adequate lip support[2]. In relation to the nose, upturning of the tip, an increase in alar base width, and an increase in nasolabial angle frequently occurs[3]. This may not be apparent immediately, as it is well documented that soft tissue swelling can take up to a year to resolve postoperatively[4]. Greater than 10% change over 5 years has been shown to continue to occur in certain regions, such as the subnasale and lips[4].

Many of the nasal changes that occur with surgery are unpredictable and are much more complex than previously thought. They depend both on the structure of the nose (nasal cartilage connective tissue, anterior nasal spine, and the other nasal cartilages) and the degree of maxillary move. Patient factors such as soft tissue morphology and thickness, postoperative healing, age, and ethnicity can also influence these changes. These changes may be either unfavourable or beneficial, depending on the preoperative nasal morphology.

The only predictable change is the nasal width. This has been known to increase with Le Fort I osteotomies. Anecdotally, the larger the maxillary move the larger the change. Adjunctive procedures to limit these changes at surgery can be undertaken, such as a cinch suture and piriform aperture sculpting. Another option would be to accept the changes and carry out procedures at a later date, the disadvantage being the requirement of an additional surgical procedure, e.g. alar wedge resection rhinoplasty. The cinch suture combined with a VY closure (ACVY) is an efficient and less invasive way to control nasolabial changes, and therefore knowledge of the long-term results of its use would be advantageous to clinicians.

Cinch suture effectiveness in the long term

The cinch suture was first described by Millard, who used it to correct nasal deformities in patients with cleft lip and palate via an extraoral approach[5]. An intraoral approach was then described by Collins and Epker, which is now utilized as the classic cinch suture[6]. There has been some debate over the effectiveness of the cinch suture in controlling the alar bases following Le Fort I osteotomy, and those with normal or slightly increased alar base widths would find the increase undesirable. Some studies have found the alar base cinch suture to limit unwanted nasal width increases[1,7–9]; however the opposing view is that this has no effect on limiting widening of the alar base and that the nasal width continues to increase over time[3,10,11]. Another concern is that the cinch suture can produce an unnatural appearance with an increase in the nasolabial angle[7].

Different methods to measure nasal changes have been described over the years. These include anthropometry, two-dimensional (2D) imaging such as photographs and cephalometric radiographs, and three-dimensional (3D) technologies such as laser scanning, cone beam computed tomography (CBCT), and stereophotogrammetry. The cost implications with the newer 3D methods have limited this research. Anthropometry can be seen as an accurate way of measuring alar base width changes compared to 2D imaging and avoids the costs of 3D imaging.

Guymon et al., in a retrospective study, compared the use of a cinch suture ($n = 13$) versus no cinch suture ($n = 15$) in 28 patients undergoing a Le Fort I procedure[1]. In their study, the cinch suture group demonstrated significantly less widening after 12 months (2.89%) when compared to the group without a cinch suture (10.75%). Although stable landmarks were chosen to allow comparison of alar base width changes preoperatively and postoperatively from the photographs, inaccuracy may still exist due to errors with the reproducibility of the photographs.

Edler et al. also measured the effects of the cinch suture on nasolabial tissues after 12 months utilizing standardized digital photographs[9]. They found similar results to Guymon et al.[1], with the alar bases increasing by a minimal amount of just 0.8 mm ± 3 mm with a cinch suture, and concluded that it was effective at controlling the alar width. However, the difference with this study compared to the former was the utilization of submental intubation. The advantages of submental intubation are that it avoids distortion of the nose by the tube, allows direct observation of nasal change during the surgery, and permits accurate placement and tightening of the cinch suture to the optimal width.

Westermark et al. also found the cinch suture to be effective at controlling the alar width, with the control group experiencing a greater increase in alar width[7]. In contrast, Betts et al. found that the cinch suture was not effective at controlling the alar width compared to the control group[3], and this was also found in other studies[10,12,13].

A limited number of recent studies have utilized 3D imaging to measure the alar base width to try and counteract the flaws of previous 2D imaging studies. A prospective randomized controlled trial was performed by Howley et al., involving 28 patients randomized by computer-generated random number sequence into a cinch suture group and a control group with no cinch suture[10]. The measurements were taken using a 3D optical surface laser scanner. The results showed that the alar base width increased by a median of 2 mm in all patients between 1 and 6 months postoperatively. The cinch suture did produce less widening of the alar base after 6 months, but this difference (0.5 mm) was stated as not clinically significant. The sample size of this study was again particularly small and it was stated by the authors that it may not be large enough to reach firm conclusions. Three surgeons operated, and although this allows applicability of the results, it can also result in variability in technique which can affect the results. Furthermore, this study only reviewed the effects after 6 months, which would not have allowed for resolution of postoperative oedema or assessment of long-term changes.

Studies utilizing CBCT images to measure nasal changes have also been performed[11,13,14]. These studies all found that the cinch suture had no effect postoperatively at controlling alar base widening. However, two of the studies only measured changes 3–6 months postoperatively when soft tissue swelling may have led to the increase in nasal width found[13,14]. van Loon et al. found that there was still widening of the nose with a cinch suture after 12 months[11]. The sample size of that study was limited to 13 patients only, with no long-term effects documented beyond the 12 months. The authors also mentioned an advantage of intraoperative measurements of the nasal width, which the present study aimed to address.

Although the short-term effects are well documented, very few studies have looked into the long-term effects on the nasal width, including the long-term stability of the cinch suture. The existing literature focuses on follow-up ranging from 6 to 12 months when soft tissue swelling may still be evident. One study that did try to determine this was performed by Stewart and Edler[8], who found that the cinch suture helped control alar flaring for 28 patients at the time of operation and that this width was stable over 1 year. The width increased by 1.5 mm with a cinch suture, which is similar to the findings of other studies. This sample size was relatively small (36 patients) and there was no indication of a sample size calculation. They also stated that a longer follow-up time of greater than 12 months would allow a more detailed view of the stability of the cinch suture.

Another problem with the previous studies is that many utilized nasoendotracheal intubation to manage the airway for orthognathic surgery in order to facilitate access to the maxilla and mandible during the osteotomy procedure. Although this is an acceptable form of intubation, it makes it difficult to observe and measure changes occurring to the nose intraoperatively. It also causes distortion to the nose and prevents accurate nasolabial measurements being taken intraoperatively. As mentioned, access for accurate placement of the cinch suture is also restricted by the nasal tube when the suture is passed from one ala to the contralateral side[15].

To address this, some have reported switching from a nasal to an oral endotracheal tube during surgery prior to tightening the cinch suture. Different techniques of switching the tube intraoperatively have been described[16]. However, as well as adding further time to the surgery, this has been reported to cause potential occlusal distortion due to anterior pressure on the maxilla and mandible, and it increases the risk of airway compromise. To provide better access in carrying out the cinch suture, Yen et al. described modifying the cinch suture technique whilst a nasal tube is in place[15]. This technique sutures the alae on both sides separately to the lower border of the piriform rim avoiding any obstruction by the nasal tube. However other surgeons have reported patients experiencing discomfort around the piriform rim postoperatively using this technique. Yen et al. reported minimal widening when a cinch suture was utilized; however the long-term effects of this beyond 6 months were not reported[15]. Their sample size was also limited to 17 patients, with no sample size calculation performed to determine whether this was large enough for a true effect to be determined.

A more practical approach to allow the nose to be visualized during orthognathic surgery, and one that was used in the study presented herein, is submental intubation where the tube is placed via an incision in the submental region (Fig. 1). This technique was first utilized by maxillofacial surgeons to control the airway in severe maxillofacial injuries when nasal or oral intubation was considered contraindicated. This not only permits an unimpeded view of the nasolabial region when maxillary orthognathic surgery is performed, but also allows better access for accurate nasolabial measurements and placement of adjunctive procedures such as a cinch suture where unwanted changes to the nose can be modified. It is also easier to assess and measure dental midlines, occlusal plane cants, and incisor exposure in relation to the upper lip, and to adjust upper lip height[17].

Fig. 1. Submental intubation.

The cinch suture can be seen as a more efficient and less invasive way to control nasolabial changes, and the results of this study provide a more long-term view, which is not present in the previous literature. The aim of this retrospective cohort study was to assess the long-term effectiveness of the nasal alar base cinch suture at controlling the alar base width following a Le Fort I osteotomy using submental intubation. The null hypothesis was that the cinch suture has no effect on limiting the increase in alar base width following a Le Fort I osteotomy and that there is no change in the alar base width in the long term.

Materials and methods

Sample, study setting, and eligibility criteria

The recruitment of participants was undertaken by a single researcher (RR). One hundred and fifty-eight participants were identified retrospectively from a laboratory technician's list of patients who had undergone Le Fort I or bimaxillary osteotomy performed by a single surgeon (HW) between January 2006 and January 2015.

A sample size calculation was performed prior to starting the study, using the mean changes from a previous study to calculate the effect size[7]. This indicated that 36 participants were required in each group to compare the alar base width changes with and without a cinch suture based on an effect size of 0.60, 80% power, and at a 5% level of significance.

The inclusion criteria were (1) white Caucasian patients who had undergone orthognathic treatment involving Le Fort I osteotomies (advancement $\pm$ impaction) performed by one surgeon (HW); (2) adult patients ($\geq$16 years) who were competent to give verbal consent and provide voluntary, valid, and informed written consent at the time of surgery; (3) intubated submentally. The following exclusion criteria were applied: congenital abnormalities; nasoendotracheal intubation; previous nasal surgery; mandibular surgery alone; inadequate (or inability to obtain) data.

Methodology process

Clinical anthropometric measurements were taken using sliding metal calipers. The lateral extremity of the alar base curvature at the alar groove (Ac–Ac) and the maximum lateral convexity of the alae of the nose (Al–Al) were measured (Fig. 2a, b). All measurements were taken to the nearest 0.5 mm. The upper lip height was also measured with a metal ruler from subnasale (the point at the base of the nose) to stomion superius (the lowest point on the vermillion of the upper lip) (Fig. 2c).

All measurements were taken by the same clinician (HW), a trained and fully calibrated single operator, at the following time points: preoperatively (T1), intraoperatively after the surgical move (T2), and then following the cinch suture, if used, on the day of surgery (T3). A cinch suture was only used if after the surgical move it was felt necessary due to adverse effects on the nasal width. Postoperative readings were taken at 12 months (T4), 24 months (T5), and 36 months (T6) by the same calibrated operator. Intra-operator reliability testing was also conducted for this single operator to ensure accuracy with repeatability of measurements.

Additional information was collected for each patient: date of birth; gender; malocclusion; ethnicity; date of operation;

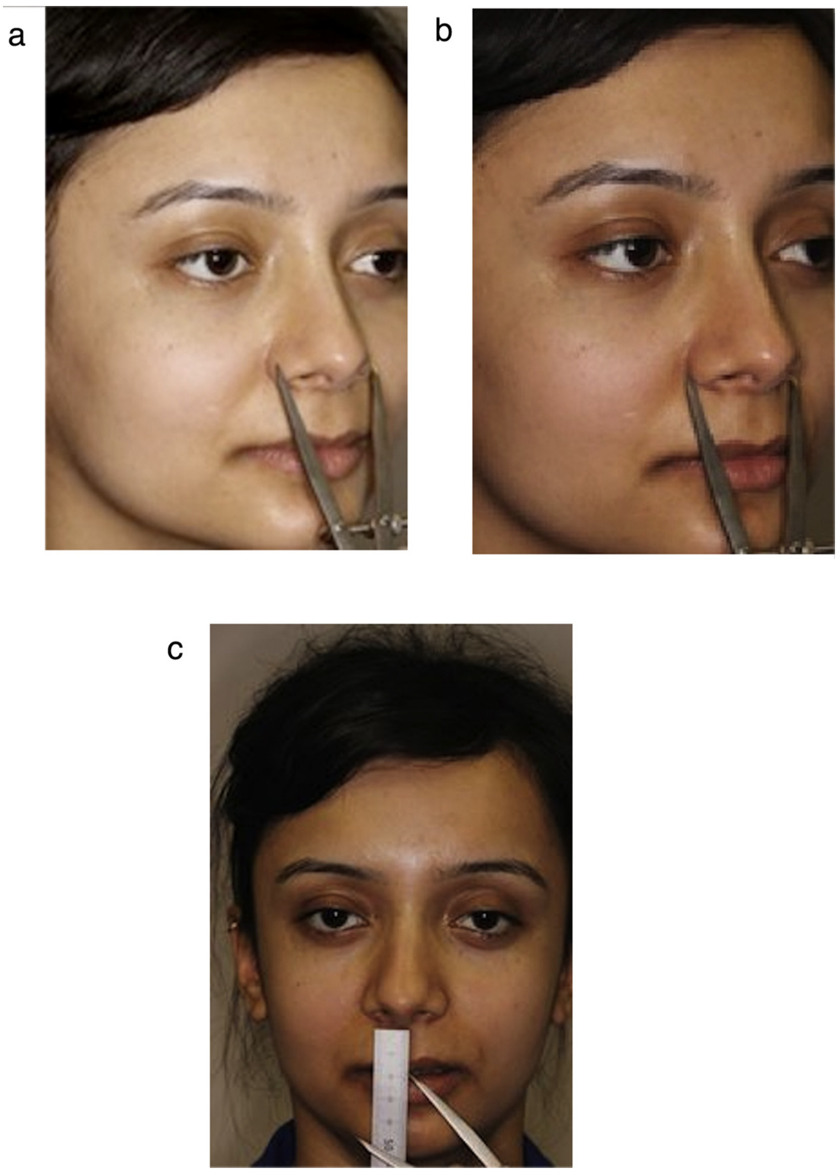

Fig. 2. Clinical measurements of (a) Al–Al width, (b) Ac–Ac width, and (c) upper lip height.

type of operation; extent of maxillary move in millimetres and direction from the operation notes; adjuncts used in the procedure such as a cinch suture and/or VY closure.

Cinch suture technique

The surgical procedure was performed by a single surgeon (HW). Preoperatively, the measurements were made as described above. Following the Le Fort I osteotomy procedure, intraoperative measurements of the nose were undertaken and the nasal width assessed. If required, the cinch suture was performed. Incisions 1–2 mm in length were made to the side of each ala with a number 11 blade (Fig. 3a). This allows the non-resorbable suture (3–0 Prolene) to be placed subcutaneously. The suture is directed from within the mouth to the extraoral alar base incision (Fig. 3b). The needle comes through the incision in the alar groove and goes back through the same incision into the mouth. A small notch at the appropriate level on the caudal edge of the septum is made. This ensures the pull of the suture is directly across the base of the nose and septum. The groove prevents the suture slipping anteriorly. Alternative techniques secure the suture to the anterior nasal spine and this tends to turn the tip of the nose upwards and produce a less aesthetic result. The suture is then passed under the septum and across to the opposite side of the extraoral alar base incision (Fig. 3c). The needle is passed back through the incision and the suture is then tied intraorally below the nasal septum. The suture is tightened to produce the required nasal base width (Fig. 3d).

Repeatability error of measurements

To determine the reproducibility of the anthropometric measurements within this study, 10 random volunteers not participating in the study or undergoing any treatment (four female and six male, aged between 25 and 40 years) had measurements taken of the nasal width (Ac–Ac and Al–Al) and the lip height using the same measuring devices as used in the study by the same calibrated operator (HW). The same measurements were then repeated 2 weeks later on the same participants to allow for a suitable ‘wash out’ period.

Statistical analyses

Stata 14 (StataCorp LP, College Station, TX, USA) was used for the data analysis. The Bland–Altman method and Lin’s correlation of concordance test were used to determine the intra-examiner reliability error.

A linear mixed-effects model analysis was used to assess the changes in the alar base width at surgery following a Le Fort I osteotomy and then again after the cinch suture. This was also used to assess the long-term stability of the nasal width and lip height and was specifically selected to allow for missing data and variable patient follow-up.

A χ^2 analysis was used to ensure that the two groups were equal in terms of the extent of maxillary move.

Results

Sample demographics

One hundred and forty participants (89 female, 51 male) fulfilled the inclusion criteria and their data were analysed in this study. Eighteen participants were excluded due to incomplete measurements or a previous rhinoplasty procedure. Female participants ranged in age from 16 to 38 years (mean 20.7 years) and male participants from 18 to 51 years (mean 22.2 years). A cinch suture was used in 106 participants and no cinch suture was placed in 34 participants.

Of the 140 participants, 102 completed the long-term follow-up. Thirty-eight participants were excluded due to the absence

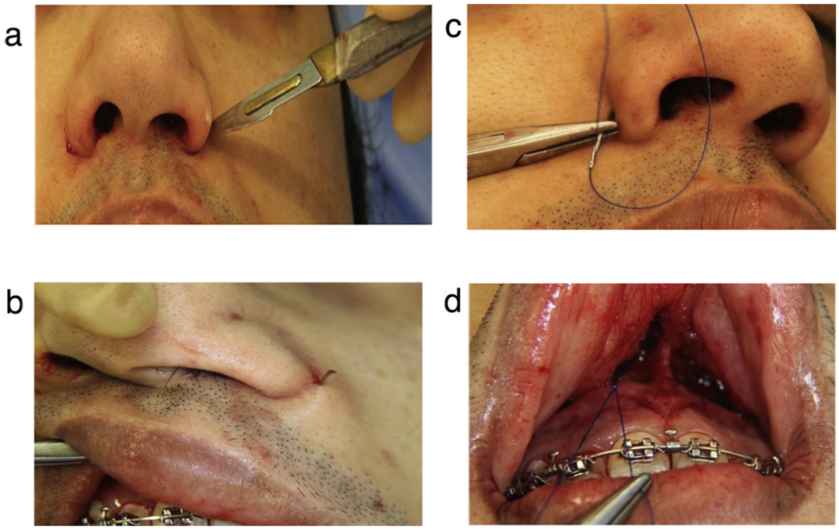

Fig. 3. Cinch suture: (a) 1–2 mm incisions are made to the side of each ala of the nose using a number 11 blade; (b) the 3–0 Prolene suture is directed from within the mouth to the extraoral alar base incision; (c) the suture is passed intraorally across to the opposite side of the extraoral alar base incision; (d) the needle is then passed back through the incision and the suture tied intraorally below the nasal septum. The suture is tightened to produce the required nasal base width.

of long-term follow-up beyond 6 months (Fig. 4). Of those completing long-term follow-up, 77 had a cinch suture placed.

The mean planned maxillary anterior advancement and anterior impaction movements were 3.5 mm ± 2.31 mm (range 2–12 mm) and 1.4 mm ± 1.79 mm (range 1–8 mm), respectively. No statistically significant difference was found between those with a cinch suture and those with no cinch suture regarding the extent of maxillary advancement ($P = 0.812$) and maxillary impaction ($P = 0.818$). Therefore the two groups could be compared at surgery.

Intra-examiner repeatability results

Ten volunteers had measurements taken of nasal width (Al–Al and Ac–Ac) and lip height, and the reliability of measurements was determined using Lin's concordance correlation coefficient (CCC) and the Bland–Altman method, which assesses combined and random systematic error. The two sets of values obtained 2 weeks apart were compared to assess reliability. A CCC value of 1 indicates perfect concordance. The results showed excellent agreement for the three measurements (>0.95), as shown in Table 1. The Bland–Altman method scatter diagrams also showed good agreement and 95% limits of agreement, which were clinically acceptable.

Alar base width changes during surgery and after cinch suture placement

Tables 2 and 3 demonstrate the differences in the two groups at surgery for widths Ac–Ac and Al–Al. Both groups demonstrated an increase in alar width following Le Fort I osteotomy. This ranged from 1 mm to 10 mm for Ac–Ac width. The largest increase in Al–Al width was 9 mm. Than the no cinch suture group had a significantly larger increase in both Ac–Ac and Al–Al following the Le Fort I osteotomy ($P < 0.0001$). However this was not clinically relevant.

Following placement of the cinch suture, the Ac–Ac and Al–Al widths decreased back to preoperative values, which was statistically significant compared to the no cinch group (both $P < 0.0001$).

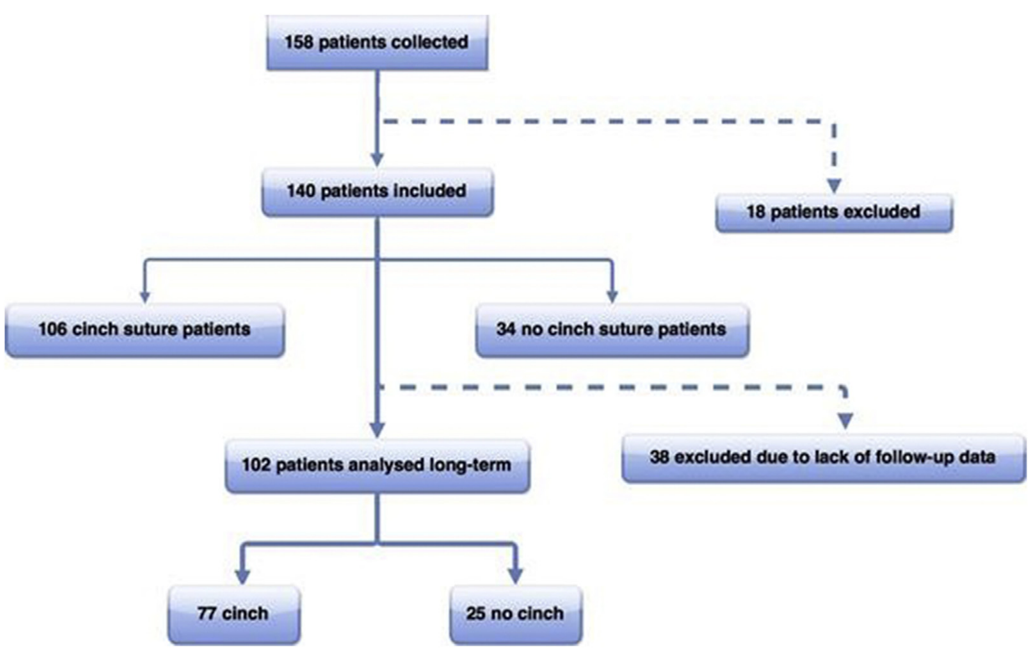

Fig. 4. Flow diagram of participants included in the results.

Table 1. Intra-examiner repeatability results.

Measurement	Mean difference	95% limits of agreement	Lin's CCC	95% CI for Lin's CCC
Ac–Ac	0.050	−1.123 to 1.223	0.990	0.977 to 1.003
Al–Al	−0.100	−0.720 to 0.520	0.997	0.993 to 1.001
Lip height	0.100	−1.013 to 1.213	0.965	0.923 to 1.006

CCC, concordance correlation coefficient; CI, confidence interval; Ac–Ac, lateral extremity of the alar base curvature at the alar groove; Al–Al, maximum lateral convexity of the alae of the nose.

Table 2. Mean differences in the Ac–Ac width of the nose (in millimetres) following Le Fort I osteotomy with and without a cinch suture.

	After osteotomy T1–T2	95% CI	Post cinch suture T1–T3	95% CI
Cinch suture (n = 106)	4.29 ($P < 0.0001$)	3.72 to 4.87	−0.14 (NS)	−0.72 to 0.43
No cinch suture (n = 34)	2.67 ($P < 0.0001$)	1.66 to 3.69	NA	1.66 to 3.69
Difference	1.62 ($P < 0.0001$)	0.81 to 2.43	2.82 ($P < 0.0001$)	

Ac–Ac, lateral extremity of the alar base curvature at the alar groove; CI, confidence interval; T1, preoperative; T2, intraoperative; T3, post cinch suture; NS, not significant ($P > 0.05$); NA, not applicable.

Table 3. Mean differences in the Al–Al width of the nose (in millimetres) following Le Fort I osteotomy with and without a cinch suture.

	After osteotomy T1–T2	95% CI	Post cinch suture T1–T3	95% CI
Cinch suture (n = 106)	3.70 ($P < 0.0001$)	3.25 to 4.14	0.02 (NS)	−0.43 to 0.46
No cinch suture (n = 34)	2.71 ($P < 0.0001$)	1.92 to 3.49	NA	1.92 to 3.49
Difference	0.99 ($P < 0.01$)	0.38 to 1.61	2.69 ($P < 0.0001$)	

Al–Al, maximum lateral convexity of the alae of the nose; CI, confidence interval; T1, preoperative; T2, intraoperative; T3, post cinch suture; NS, not significant ($P > 0.05$); NA, not applicable.

Long-term changes in the alar base width, with and without a cinch suture

Table 4 shows that there were no statistically significant changes at 3 years in the Al–Al width with a cinch suture ($P > 0.05$). The increase in Ac–Ac width at 3 years was just statistically significant with a P-value of 0.04; however this change was not clinically relevant.

Table 5 demonstrates that at 3 years, there was no statistically significant difference in the width of the nose compared to post-surgery when a cinch suture was not performed (Al–Al, $P = 0.63$; Ac–Ac, $P = 0.98$). The Al–Al width actually decreased by 0.5 mm at 1 year, and decreased further at 2 years. The Ac–Ac width showed an increase of 0.41 mm at 3 years, which was not statistically significant. Without a cinch suture placed, the alar width tended to decrease over time, but by a clinically insignificant amount (<1 mm).

Discussion

The aim of this study was to investigate the effect of the cinch suture on the alar base width following a Le Fort I osteotomy with submental intubation, intraoperatively and postoperatively, and to

Table 4. Long-term mean change in width of the nose (in millimetres) following cinch suture placement (T3) to follow-up at 1 year, 2 years, and 3 years.

	T3 to 1 year (n = 38)			T3 to 2 years (n = 36)			T3 to 3 years (n = 18)		
	Mean change	P-value	95% CI	Mean change	P-value	95% CI	Mean change	P-value	95% CI
Al–Al	0.97	<0.0001	0.44 to 1.50	0.34	0.46	−0.20 to 0.89	0.36	0.72	−0.37 to 1.09
Ac–Ac	0.91	0.006	0.19 to 1.64	0.68	0.09	−0.06 to 1.43	1.03	0.04	0.03 to 2.03

CI, confidence interval; T3, postoperative following cinch suture placement; Al–Al, maximum lateral convexity of the alae of the nose; Ac–Ac, lateral extremity of the alar base curvature at the alar groove.

Table 5. Long-term mean change in width of the nose (in millimetres) without a cinch suture from post surgery (T2) to follow-up at 1 year, 2 years, and 3 years.

	T2 to 1 year (n = 16)			T2 to 2 years (n = 10)			T2 to 3 years (n = 7)		
	Mean change	P-value	95% CI	Mean change	P-value	95% CI	Mean change	P-value	95% CI
Al–Al	−0.45	0.66	−1.29 to 0.40	−0.96	0.07	−1.98 to 0.05	−0.64	0.63	−1.82 to 0.54
Ac–Ac	−0.59	0.70	−1.75 to 0.57	−0.66	0.75	−2.06 to 0.73	0.41	0.98	−1.22 to 2.03

CI, confidence interval; T2, post-surgery; Al–Al, maximum lateral convexity of the alae of the nose; Ac–Ac, lateral extremity of the alar base curvature at the alar groove.

determine the stability of the cinch suture in maintaining the desired width in the long term. This study demonstrated that the alar base cinch suture was effective at reducing the unwanted widening effect seen immediately following a Le Fort I osteotomy. There was some relapse over the first 12 months, but there was minimal change in nasal width following this for up to 3 years.

In the previous literature, some authors found the cinch suture to have little effect on preventing significant widening of the alar base after a Le Fort I osteotomy[3,10–12,18], whereas others demonstrated a beneficial limitation of widening of the alar base following osteotomy and favoured its use[1,8,9,15,19].

Very few studies have quantified the effect on the nasal width at various stages during surgery, with measurements usually being reported approximately 6 months to a year after. Only one other study has measured these effects, and that study demonstrated similar findings to the present study, with a mean increase of 3 mm following surgery[8]. A recent CBCT study by van Loon et al., who found that the cinch suture did not limit nasal widening, stated that intraoperative measurements would be advantageous to allow further control of the nasal width with the cinch suture[11]. The present study revealed that immediately following surgery, the cinch suture helped reduce the alar bases back to approximately their preoperative width and this decrease was statistically significant. This is in contrast to the findings of Stewart and Edler, where the cinch suture reduced the nasal width but by only half the amount (1.6 mm) of the intraoperative change[8]. This could partly be explained by their small sample size of 28 participants in comparison to 106 in this study, but could also be related to a difference in operator technique. The present study also demonstrated how significant the nasal changes are immediately following the maxillary surgical move.

This study investigated the long-term effects of the cinch suture up to 3 years postoperatively, which is possibly the longest review period studied. Intervals of 1 and 2 years were also analysed in order to determine at what point the relapse may occur. The results indicate that following an initial small relapse, the cinch suture is stable long term at maintaining the reduced nasal width with minimal changes. The largest change was seen at 3 years postoperative, with a statistically significant difference in Ac–Ac width compared to that at the time of surgery; however this was not clinically significant. The findings of Stewart and Edler are in agreement with the present findings of a greater increase of 1 mm in the Ac–Ac width compared to Al–Al at follow-up, but also after the osteotomy (0.6 mm)[8]. They explained that the difference in Ac–Ac and Al–Al may be due to the temporary absence of the nasofacial groove after the osteotomy in the Ac–Ac width, which is recreated with the cinch suture[8]. This also demonstrates that the nasal base (Ac–Ac) can possibly be influenced by changes in weight.

Other studies are also in agreement with the current results, showing the cinch suture to lead to a beneficial reduction in nasal width compared with no cinch suture placement at up to 12 months postoperative[1,7,15]. Edler et al. also found that the cinch suture limited widening of the nasal width (0.8 mm) at 9–12 months following Le Fort I osteotomy[9]. This was also found by Shoji et al., with increases of 0.28 mm at 12 months[19]. Both studies utilized submental intubation, allowing better visualization and providing unobstructed access to place the cinch suture, which other studies may have found difficult due to the nasal tube[8,9]. However, all studies compared the long-term changes with the preoperative nasal width measurement rather than following cinch suture placement postoperatively, which was performed in this study. Comparison to the preoperative measurement can introduce other confounding factors present during the surgery that have not been accounted for.

Conversely, studies utilizing 3D methods disagree with the findings of the present study. They found that despite the use of a cinch suture, the alar bases increased clinically by more than 2 mm. These studies share a common trend in that their follow-up was limited to 6 months[10,13,14,20]. Therefore the increased width may be due to postoperative swelling. Results from the studies by Howley et al.[10] and more recently van Loon et al.[11] could be explained by the small sample size of participants in their cinch suture group, with no sample size calculation performed, therefore lacking sufficient power to obtain a significant result.

Similar conflicting results were found in a prospective study using anthropometric measurements performed by Khamashta-Ledezma and Naini where a difference of only 0.08 mm was found between the cinch and no cinch patients after 6 months, despite statistical significance[18]. This again can be explained by the small number of participants in both groups, short follow-up time, and multiple surgeons operating with varied techniques. The findings of Betts et al. also disagree with the current findings, as the cinch suture actually widened the alar base rather than reducing it at 12 months compared to the no cinch group[3]. This can possibly be explained again by the small sample size and the possible methodology involving nasal casts to measure the alar base width.

Chung et al. demonstrated that despite a cinch suture, widening of the Al–Al by an average of 2.2 mm and Ac–Ac by 1.24 mm occurred at 10 months[12]. This larger result compared to the present study could be due to their Korean sample of patients, who commonly present with naturally wider alar widths preoperatively, and also the difference in structure of the nose compared to the average Caucasian patient, which may be more susceptible to widening. Chung et al. used a modified cinch suture rather than the classic cinch suture used in the current study, which may have contributed to the results[12]. Additionally, the suture material used was 2–0 resorbable Vicryl, as it was believed that the scar tissue formed would maintain the results. Therefore, after 10 months there may have been further relapse potential for patients with a resorbable suture, which could affect the long-term stability[12]. In the current study, the surgeon used non-resorbable 3–0 Prolene for all patients and found minimal changes in the nasal width at 3 years compared to the preoperative value.

Other variables such as the actual technique may also differ between surgeons, including the amount of tightening of the suture to achieve the desired effect. The landmarks to measure the alar width may also vary slightly when comparing this study with other studies, as well as whether the patient was sitting upright or was in a supine position during measurements, which can affect the nasal width. Weight changes can also have effects on the nose, which could have had an impact on the results. This is demonstrated by the long-term results in this study for the no cinch suture participants, in whom nasal width changes still occurred, although they were minimal (0.5–1 mm).

Although previous studies have shown that the cinch suture can reduce the alar width, the long-term stability of the cinch suture has not been well documented. This study sought to address this issue. In the current study, patients were reviewed from 12 months onwards, as it is well documented in a long-term study of over 5 years that most of the horizontal and vertical soft tissue changes occur in the first year after surgery[4]. Two studies found little change in the alar width from 3 months to a year, which is surprising given the amount of soft tissue swelling evident up to 12 months. However, this indicated that the cinch suture was stable in the medium term, with effects after 12 months not being investigated[8,9]. The extent of maxillary move also needs to be taken into consideration with regard to nasal changes, as the larger the move, the larger the change[13]. The average mean maxillary anterior advancement and anterior impaction movements in the current study were 3.5 mm $\pm$ 2.31 mm (range 2–12 mm) and 1.4 mm $\pm$ 1.79 mm (range 1–8 mm), respectively. These may be lower than those in other studies; however this study aimed to look at the effect of the cinch suture following surgery and whether this was maintained long-term, rather than the extent of maxillary move versus nasal changes.

This study was designed to evaluate the effectiveness of the cinch suture in controlling the unwanted widening of the alar base following a Le Fort I osteotomy and whether this was stable in the long-term. On the basis of the results of this study of 140 participants treated with a Le Fort I osteotomy, with or without alar base cinch sutures, the primary null hypothesis stating that cinch sutures have no effect on the inter-alar width can be rejected. The second null hypothesis regarding no long-term changes in the inter-alar width can be accepted, as little change occurred over 3 years.

The following conclusions may be drawn: (1) an alar base cinch suture is effective at reducing the inter-alar width to its preoperative width following a Le Fort I osteotomy; (2) this cinch suture is stable in the medium and long-term at 12 months and 3 years postoperatively, with little relapse in the Al–Al width (<0.5 mm) and approximately 1 mm relapse in the Ac–Ac width.

Patient consent

Written and verbal consent was obtained to publish the photographs.

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None.

Ethical approval

City and East NHS Research Ethics Subcommittee (NRES) (REC number 14/LO/1957; IRAS Project ID 151475) agreed ethical approval on 24 October 2014. The Research and Development Committee at St George's Healthcare NHS Trust (ID 15.0026) approved the study on 3 February 2015.

Competing interests

None.

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Corresponding author
E-mail: *Helen.Witherow@stgeorges.nhs.uk*