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Original Article

Effects of Cartilage Scoring in Correction of Prominent Ear with Incisionless Otoplasty Technique in Pediatric Patients

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OBJECTIVE: The aim of this study was to investigate the efficacy, complication rates, patient satisfaction, and recurrence risks of the incisionless otoplasty technique performed with or without cartilage scoring for correcting the prominent ear in pediatric patients.

MATERIAL and METHODS: A total of 49 patients with prominent ears were operated with incisionless otoplasty. In Group 1, 44 ears of 24 patients were operated with incisionless otoplasty without cartilage scoring. In Group 2, 46 ears of 25 patients were operated with incisionless otoplasty with cartilage scoring. For comparison, auriculocephalic distances were measured at three different levels: preoperatively, at the end of surgery, and at 1th and 6th month post-operatively. Patient satisfaction was evaluated using a visual analog scale (VAS). The global esthetic improvement scale (GAIS) was applied by an independent, non-participating plastic surgeon at 6 months after surgery.

RESULTS: Prior to surgery and at the end of surgery, no statistically significant difference was observed between the groups in terms of auriculocephalic distances at the three levels. At the and 6th month after surgery, auriculocephalic distances were significantly higher in Group 1. There were no significant differences in VAS results and GAIS values between the groups. The recurrence rate was 9.1% in Group 1 and 4.3% in Group 2. The suture extrusion rate was 18.2% in Group 1 and 13% in Group 2.

CONCLUSION: Although there was a significant difference of 1–2 mm in auriculocephalic distances, our study showed that cartilage scoring is not mandatory to correct the prominent ear in pediatric patients with soft cartilages and to achieve patient and surgeon satisfaction.

KEYWORDS: Prominent ear, cosmetic surgery, incisionless otoplasty, scoring

INTRODUCTION

A protruding ear is the most common congenital external ear deformity, affecting 5% of the healthy population with an autosomal dominant transition [1, 2]. A protruding ear is an esthetic problem that may cause psychological side-effects such as lack of self-confidence, emotional trauma, and psychological stress in children because of humiliation by their peers [3, 4]. To prevent these psychological side-effects, the correction of the auricle is mostly performed at approximately 6 years of age before the child starts school and the development of the auricle is mostly completed, as recommended [5, 6].

To achieve an ideal shape of the pinna, the exact problems leading to a protruding ear should be laid down. The main causes of a prominent ear are an inadequately developed antihelical curve, a hypertrophic conchal bowl, or the presence of both [7]. Over 200 surgical procedures have been described since the first surgical method was reported in the 19th century [8, 9]. There is no appropriate surgical procedure to correct all protruding ears [9]. Cartilage incision techniques and cartilage sparing with suture placement techniques are the two main categories of surgical correction of a protruding ear.

In 1958, Gibson and Davis introduced the balance beam theory of cartilage behavior. In this study, they first showed that by partially releasing the internal self-locked stress system on one side, the cartilage tends to warp to the opposite side [10]. After this finding, Stenström described an anterior scoring technique to correct congenital prominent ears in 1963 [11]. In the same year, Chongchet [12] described sharp anterior scoring with a scalpel to form the anti-helix. Different techniques and different instruments have been reported for cartilage scoring. Incision of the cartilage with a scalpel blade, abrading with a diamond-coated file, scoring with a needle, and squeezing with Adson-Brown forceps have all been used to weaken the cartilage [12-15].

In 1967, Mustarde described a well-known suture technique that did not involve cartilage scoring [16]. Mustarde performed multiple permanent horizontal mattress sutures to fix the new antihelical fold. Because the procedure needs a skin incision and a posterior

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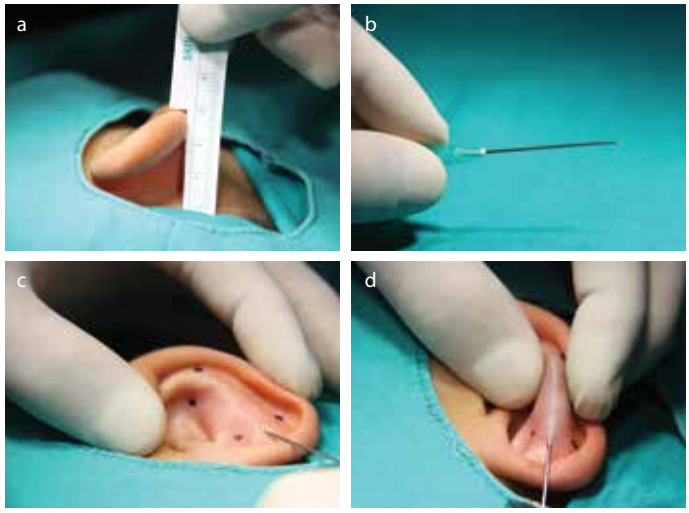

Figure 1. a-d. Prior to surgery, the auriculocephalic distances were measured and recorded at three levels (a), a 21-gauge needle was used, and we created a new curve to its tip for cartilage scoring in order to weaken it (b), the needle entered the skin from the superiormost part of the desired antihelical fold. The needle penetrated the skin with its sharp edge, following which the tip was rotated toward the cartilage. First, multiple partial cuts were longitudinally applied at the area of the desired antihelical fold (c), then, starting from the farthest point to the first entry, multiple partial cuts were horizontally applied to the cartilage (d).

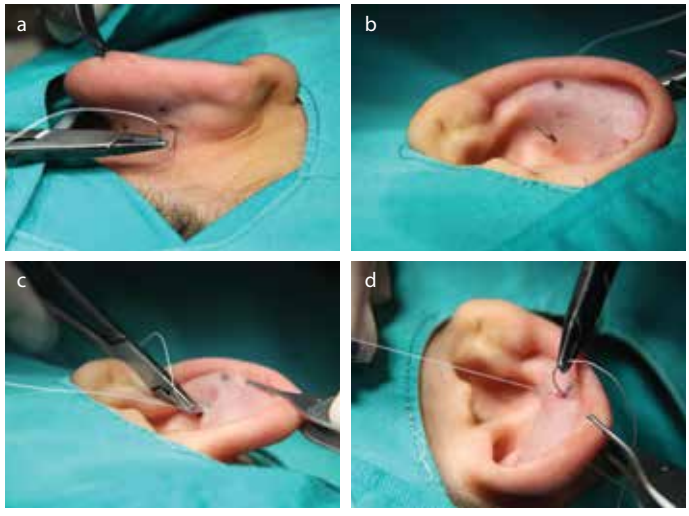

Figure 2. a-d. To hide the knots, the suture settling was first started in the rear of the auricle. The needle entered the skin at a 90° angle from the posterior surface of the auricle (a), the needle penetrated the full thickness cartilage to exit from the skin in front of the auricle (b), the needle re-entered from its exact exit hole, and it rose up to its second exit hole (c), the needle re-entered from the second exit hole at a 90° angle (d).

approach, there are risks of complications such as hemorrhage, keloid generation, and a remarkable scar. To avoid these complications because of the need for skin incision to place the Mustarde sutures, Fritsch developed an incisionless otoplasty technique to create the missing antihelical ridge [17]. The first step of this procedure was cartilage scoring. He managed to combine scoring and suturing techniques without a skin incision.

In the literature, there is no consensus about the necessity of cartilage scoring as a major step of an incisionless otoplasty procedure. Successful results have been published about incisionless otoplasty, including

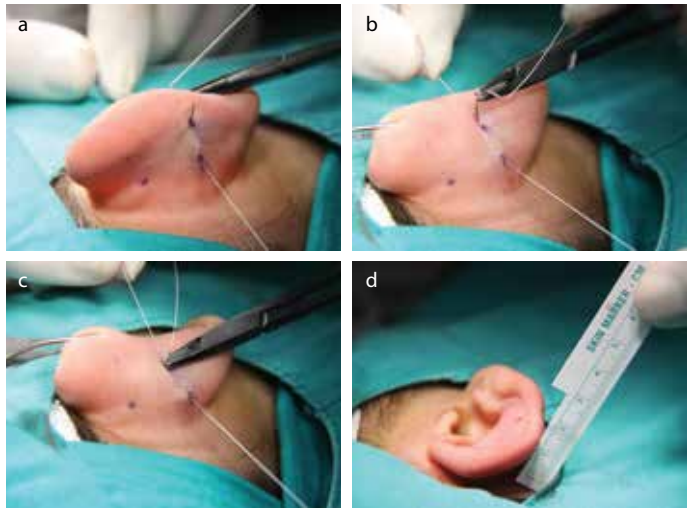

Figure 3. a-d. The needle penetrated the full thickness cartilage toward the posterior surface of the auricle (a), the needle re-entered from the exact exit hole in the posterior of the auricle (b), the needle led downward to exit from its first original entry hole (c), after the sutures were knotted and tightened, the measurements for auriculocephalic distances were performed again from the three levels (d).

scoring, suturing, or their combination. Ozturan et al. [18] described an incisionless suturing otoplasty technique that did not include scoring. In contrast, Rauing reported an otoplasty technique that included scoring without suturing and achieved successful results [14].

In a study published in 2014, Haytoglu et al. [19] performed an incisionless otoplasty modification, including both suturing and scoring, in 26 patients. To weaken the cartilage, a 21-gauge needle was used by reshaping its pin. In this study, successful results and high patient satisfaction were achieved. In the present study, we performed otoplasties with this incisionless technique to investigate the difference on including scoring. To the best of our knowledge, this is the first study comparing the incisionless otoplasty technique performed with and without cartilage scoring. We investigated the efficacy of cartilage scoring by comparing the auriculocephalic distances as objective criteria, and the global esthetic improvement scale (GAIS) and visual analog scale (VAS) for patient satisfaction as the subjective criteria. We also investigated the complication rate and recurrence risk of the procedures.

MATERIALS and METHODS

Forty-nine patients (20 female and 29 male) with prominent ears operated by the first author between October 2011 and June 2014 were included in this study. As incisionless otoplasty is effective in ears with soft cartilages, the patients under 18 years old were included in this study. Patients who have psychiatric disorders, a history of otoplasty, mental retardation, and congenital craniofacial anomaly were excluded. Patients with conchal bowl hypertrophy were also excluded. The patients were randomly divided into two groups. Fifteen male and 9 female patients were included in Group 1, while 14 male and 11 female patients were included in Group 2. In Group 1, 44 ears of 24 patients (20 bilateral and 4 unilateral) were operated with the incisionless otoplasty technique without cartilage scoring. In Group 2, 46 ears of 25 patients (21 bilateral and 4 unilateral) were operated with the incisionless otoplasty technique with cartilage scoring. Surgical procedures were performed by the first author. Medical photo-

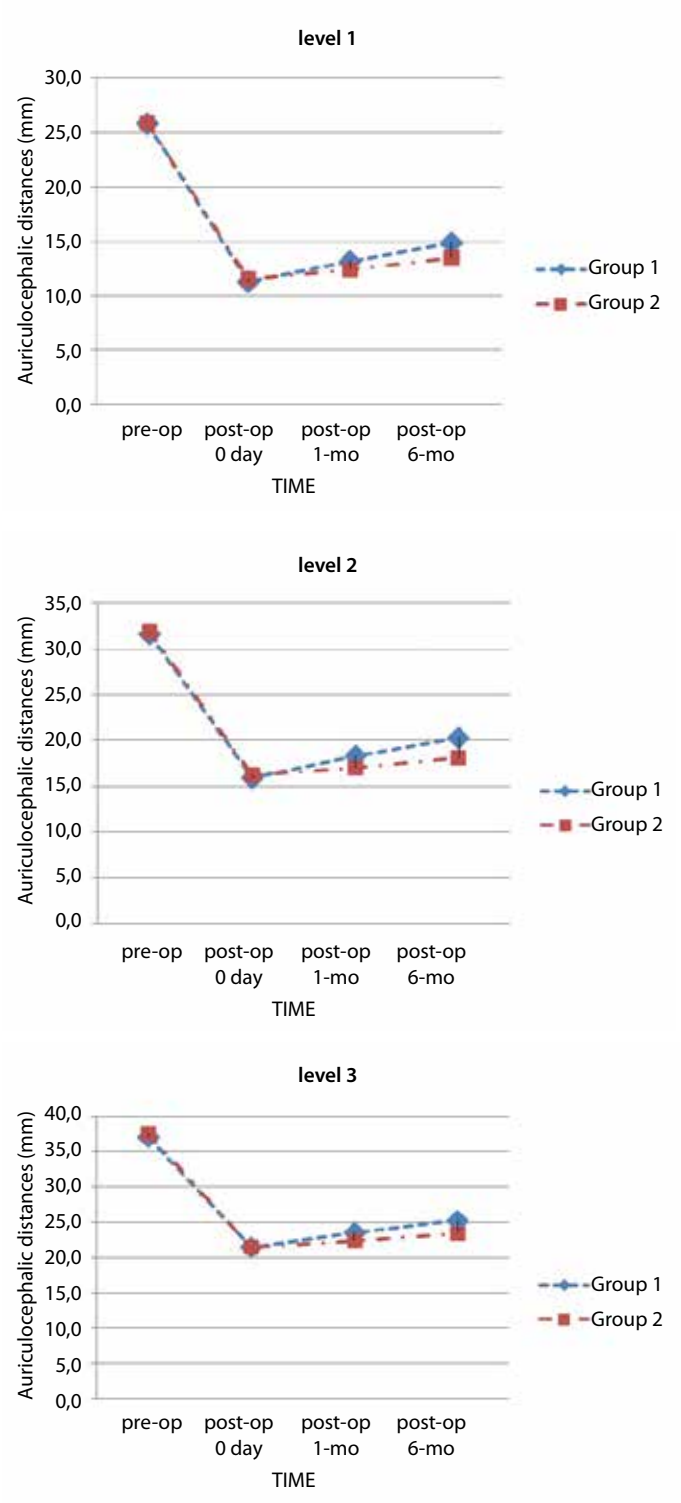

Figure 4. Comparison of auriculocephalic distances between the groups at levels 1, 2, and 3 separately.

graphs of all the patients were recorded from four different angles (anterior, posterior, left, and right profiles) pre-operatively and at post-operative 6 months.

Surgical Procedure

Under general anesthesia, the auriculocephalic distances at 3 levels were measured and recorded. (Figure 1a). The measurements were done at level 1 (L1) (the most upper point of the pinna), level 2 (L2) (midpoint of the auricle), and level 3 (L3) (the level of the lobule). The suture locations were marked with a surgical pen at the anterior and posterior surface of the auricle. The following step for Group 2 was scoring. To weaken the cartilage, a 21-gauge needle (Ayset, Adana, Turkey), in which we had created a new curve to its tip, was used for cartilage scoring both longitudinally and horizontally (Figure 1b-d). The following steps were the same for both groups (Figure 2, 3). The first suture was placed at level 2. To hide the knots, the suture settling was first started in the posterior of the auricle (Figure 2a). The needle enters the skin at a 90° angle to penetrate the cartilage's full thickness and exits from the anterior surface of the auricle (Figure 2b). The needle re-enters from its exit hole and scrolls up to its second exit hole (Figure 2c). Then it re-enters from the second exit hole at a 90° angle and penetrates the full-thickness cartilage toward the rear of the auricle (Figure 2d, 3a). Then, the needle enters from this exit hole in the rear of the auricle, and leads downward to its first original entry hole (Figure 3b, c). The suture is knotted and tightened, and the knots are buried under the skin on posterior surface of the auricle. The second stitch is placed almost over the crura anti-helix junction. After the suture placements, the measurements are taken again at the three levels (Figure 3d). For patients over 7 years old, no ear dressing was done. If the patient was younger than 7 years old, an ear dressing was applied for just one day post-operatively. The follow-up period was at least six months, and measurements were repeated at the 1st and 6th months post-operatively.

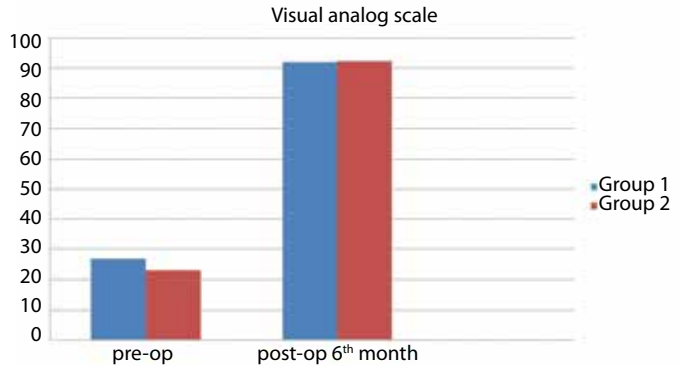

Figure 5. VAS results at pre-operative and post-operative 6th month for the groups.

Before surgery and 6 months after the operation, patient satisfaction was measured with a VAS on 0 to 100 scale. For the children below 12 years old, the scoring was performed by the parents. The GAIS was performed by a plastic surgeon, who had not participated in the actual surgery, at the post-operative 6-month period. This surgeon, who was blinded to randomization, compared the patients with their photos taken pre-operatively and then rated them as improved, no change, or worse.

Statistical Analysis

Statistical Packages for Social Science (Version 20.0, IBM Corp.; Armonk, NY, USA) was used for the statistical analysis. The Chi-square test was used to compare the mean ages, VAS values, GAIS values, and suture extrusion rates between the groups. The Wilcoxon sign test was used for pairwise comparison of the changes of auriculocephalic distances in each group. The Mann–Whitney U test was used to

Table 1. Results of comparisons between groups for auriculocephalic distances at levels 1–3

		n	Mean	Median	Minimum	Maximum	SD	z	p
Pre-op level 1	Group 1	44	25.8	26.0	22.0	28.0	1.5	−0.371	0.712
	Group 2	46	25.9	26.0	22.0	35.0	2.3		
	Total	90	25.9	26.0	22.0	35.0	2.0		
Post-op 0 day level 1	Group 1	44	11.3	11.0	10.0	12.0	0.8	−0.795	0.426
	Group 2	46	11.5	11.5	10.0	15.0	1.3		
	Total	90	11.4	11.0	10.0	15.0	1.0		
Post-op 1st month level 1	Group 1	44	13.2	13.0	11.0	20.0	1.6	−3.004	0.003*
	Group 2	46	12.4	12.0	10.0	18.0	1.7		
	Total	90	12.8	12.0	10.0	20.0	1.7		
Post-op 6th month level 1	Group 1	44	14.9	14.0	12.0	26.0	2.9	−3.525	0.0001*
	Group 2	46	13.5	13.0	11.0	23.0	2.0		
	Total	90	14.1	14.0	11.0	26.0	2.6		
Pre-op level 2	Group 1	44	31.6	32.0	28.0	35.0	1.8	−0.389	0.697
	Group 2	46	31.9	32.0	28.0	40.0	2.3		
	Total	90	31.8	32.0	28.0	40.0	2.1		
Post-op 0 day level 2	Group 1	44	15.9	16.0	15.0	17.0	0.5	−1.345	0.179
	Group 2	46	16.2	16.0	15.0	20.0	0.9		
	Total	90	16.1	16.0	15.0	20.0	0.8		
Post-op 1st month level 2	Group 1	44	18.3	18.0	16.0	27.0	2.3	−4.072	0.0001*
	Group 2	46	17.0	17.0	15.0	23.0	1.4		
	Total	90	17.6	17.0	15.0	27.0	2.0		
Post-op 6th month level 2	Group 1	44	20.3	20.0	16.0	32.0	3.3	−4.684	0.0001*
	Group 2	46	18.1	18.0	15.0	29.0	2.2		
	Total	90	19.2	19.0	15.0	32.0	3.0		
Pre-op level 3	Group 1	44	37.1	37.0	32.0	41.0	2.2	−1.082	0.279
	Group 2	46	37.6	38.0	32.0	44.0	2.5		
	Total	90	37.3	38.0	32.0	44.0	2.4		
Post-op 0 day level 3	Group 1	44	21.5	21.5	20.0	23.0	0.6	−1.515	0.131
	Group 2	46	21.5	21.0	20.0	28.0	1.6		
	Total	90	21.5	21.0	20.0	28.0	1.2		
Post-op 1st month level 3	Group 1	44	23.5	23.0	20.0	31.0	1.9	−3.946	0.0001*
	Group 2	46	22.4	22.0	20.0	29.0	1.9		
	Total	90	22.9	23.0	20.0	31.0	2.0		
Post-op 6th month level 3	Group 1	44	25.3	25.0	21.0	34.0	2.6	−4.349	0.0001*
	Group 2	46	23.4	23.0	21.0	32.0	2.1		
	Total	90	24.4	24.0	21.0	34.0	2.5		

*p value shows the results of Mann–Whitney U test.
Pre-op: preoperative; Post-op: postoperative; n: number of ears; SD: standart deviation

compare the auriculocephalic distances between the groups at levels 1, 2 and 3. A p value of <0.05 was considered statistically significant.

Local ethics committee approval was also taken. Patients were included in the study after the signing of informed consent by the parents.

RESULTS

The mean age of the patients was 7.7±2.8 years in Group 1 (without scoring) and 8.1±3.1 years in Group 2 (with scoring). There was no significant statistical difference between the two groups regarding age (p=0.331). The mean operation time was 14.1±4.9 min in Group 1 and 16.1±5.2 min in Group 2. No significant statistical differences were observed between the groups for the operation time.

The results of the comparisons between the groups for auriculocephalic distances are shown in Table 1.

Group 1, for L1, the mean distances (MD) were 25.8±1.5 mm prior to surgery, 11.3±0.8 mm at the end of surgery, 13.2±1.6 mm

at post-operative 4 weeks, and 14.9±2.9 mm at post-operative 6 months. For L2, MD was 31.6±1.8 mm prior to surgery, 15.9±0.5 mm at the end of surgery, 18.3±2.3 mm at post-operative 4 weeks, and 20.3±3.3 mm at post-operative 6 months. For L3, MD was 37.1±2.2 mm prior to surgery, 21.5±0.6 mm at the end of surgery, 23.5±1.9 mm at post-operative 4 weeks, and 25.3±2.6 mm at post-operative 6 months.

Group 2, for L1, MD was 25.9±2.3 mm prior to surgery, 11.5±1.3 mm at the end of surgery, 12.4±1.7 mm at post-operative 4 weeks, and 13.5±2.0 mm at post-operative 6 months. For L2, MD was 31.9±2.3 mm prior to surgery, 16.2±0.9 mm at the end of surgery, 17.0±1.4 mm at post-operative 4 weeks, and 18.1±2.2 mm at post-operative 6 months. For L3, MD was 37.6±2.5 mm prior to surgery, 21.5±1.6 mm at the end of surgery, 22.4±1.9 mm at post-operative 4 weeks, and 23.4±2.1 mm at post-operative 6 months.

The changes of auriculocephalic distances between the groups for levels 1–3 are shown in Figure 4.

Prior to surgery and at the end of the surgery, a statistically significant difference was not observed between the groups for the auriculocephalic distances at levels 1, 2, and 3 ($p>0.05$).

At the 4th week after surgery and at the 6th month after surgery, the auriculocephalic distances at levels 1,2, and 3 were significantly higher in Group 1 when compared with Group 2 ($p<0.05$).

Symmetry was evaluated by comparing the ears with the other side for patients performed otoplasty bilaterally. MD was 2.6 mm at L1, 2.6 mm at L2, and 2.4 mm at L3 for Group 1 and 2.2 mm at L1, 2.5 mm at L2, and 2.3 mm at L3 for Group 2. No statistically significant difference was observed between the groups ($p>0.05$).

The GAIS was improved in 90.9% of ears and no change in 9.1% in Group 1 and improved in 95.7% and no change in 4.3% in Group 2. No patient was rated as "worse" in either group. A significant difference was not observed between GAIS values of Group 1 and Group 2 ($p>0.05$).

The VAS rated by patients or their parents to evaluate satisfaction was 26.9±9.3 pre-operatively, and this increased significantly to 91.9±8.3 at post-operative 6 months in Group 1 ($p<0.0001$). In Group 2, the VAS score was 23.0±9.5 pre-operatively, and significantly increased to 92.3±7.5 at 6 month post-operatively ($p<0.0001$) (Figure 5). No significant differences were observed in the VAS results between groups at the pre-operative and post-operative 6 month periods, separately ($p>0.05$).

Hemorrhage, keloid formations, hematomas, and sharp contours or irregularities did not occur in any patient in the two groups. Infection occurred in 1 patient in Group 1 after a minor trauma 2 months after surgery, whereas no infection was observed in Group 2.

In our study, the recurrence rate was 9.1% (4 of 44 ears) in Group 1 and 4.3% (2 of 46 ears) in Group 2. These patients were operated with the same technique in their group. After revision surgery, the follow-up period was a minimum of 6 months and recurrence was not observed.

The suture extrusion rate was 18.2% in Group 1 and 13% in Group 2. No statistical significant difference was observed between the two groups for suture extrusion ($p>0.05$).

DISCUSSION

Over 200 surgical procedures for correcting the prominent ear have been described to achieve symmetrical, natural-looking ears with no sign of surgery [8]. Because of the numerous problems leading to a protruding ear, no appropriate single procedure has been described for correcting all deformities [9]. Therefore, a surgeon should decide the appropriate surgical procedure to correct the prominent ear according to the problems leading to the deformity and according to his/her surgical experience. The incisionless technique is a good option for otoplasty in patients with an isolated, insufficiently developed anti-helix and with soft auricular cartilages [18, 19]. In the present study, we performed incisionless otoplasties with a modification, as described in the previous studies [19, 20]. In another study, this modification also showed similar results to those obtained with Fritsch's incisionless otoplasty technique in terms of efficacy and with lower complication rates for correcting prominent ears in children [20].

In this study, we investigated the effect of the use of cartilage scoring as one step of the incisionless otoplasty technique on the success rate, patient satisfaction, complication rates, and recurrence risk. For this purpose, we performed otoplasties just for a difference about including the scoring. To weaken the cartilage, a 21-gauge needle, in which we created a new curve to its tip, was used for cartilage scoring both longitudinally and horizontally. With the new shape of the needle tip, we could perform partial cuts to one side of the cartilage in the area of the intended anti-helix with no need for a skin incision. According to the balance beam theory introduced by Gibson and Davis, by partially releasing the internal self-locked stress system at one side, the cartilage tends to warp to the opposite side [10]. We scored the cartilage with multiple partial cuts based on this theory in Group 2 patients (with scoring).

In the literature, there are studies reporting the otoplasty with no need for scoring to create the anti-helix [16, 18, 21, 22]. Ozturan et al. [18] reported successful results for an incisionless otoplasty technique without cartilage scoring. The technique needed three sutures and a special surgical instrument, a needle carrier. Furthermore, some authors reported successful results of otoplasty including scoring without suturing to create the anti-helix [14, 23, 24]. However, there are some limitations of the otoplasty techniques that include scoring without suturing, such as these techniques need a prolonged ear dressing for up to seven days after surgery, and, after removing the dressing, the intended anti-helix needs to be preserved with fixate to the mastoid with adherent strips for six weeks. In the present study, ear dressing was used just for the first day after surgery for children under 7 years old to prevent them touching the ear.

Ito et al. [25] reported that replacing the elastic auricular cartilage fibers by collagen-like fibers increase at an advanced age. This study shows the reason for thick auricular cartilages in adults. Based on this result, some authors recommended to use cartilage scoring as a step of otoplasty in adults [18, 26]. In our study, the mean age of the patients was 7.7±2.8 years in Group 1 (without scoring) and 8.1±3.1 years in Group 2 (with scoring). In the literature, there is no previous publi-

cation about the effect of cartilage scoring as a part of incisionless otoplasty in pediatric patients with prominent ears.

The mean operation time was 14.1±4.9 min in Group 1 and 16.1±5.2 min in Group 2. No significant statistical difference was observed between the groups for the operation time. Scoring is not a time-consuming activity, it takes approximately 2 min. In the study conducted by Mandal et al. [21] the authors reported a median of 45 min for the operation time in the group with just anterior scoring performed. They performed the standard Chognet's anterior scoring technique. The delay in operation time may be due to the skin incisions. In our study, we scored the cartilage from a needle hole without a skin incision.

In both groups, a slight rise was observed in auriculocephalic distances. There was no significant differences of auriculocephalic distances at levels 1-3 between the groups prior to surgery and at the end of surgery, separately. At the 4th week after surgery and at the 6th month after surgery, the auriculocephalic distances at levels 1, 2, and 3 were significantly higher in Group 1 when compared with Group 2. The reason for this result may be due to creating the desired anti-helix as close as possible to normal ears in both groups at the end of surgery, but at the 4th week after surgery and the 6th month after surgery, the results were significantly higher in Group 1 (without scoring) because of the intact internal self-locked stress system. The cartilage tended to return to its initial position because of the cartilage memory, and the resistance of the sutures may not have been enough to prevent this exactly.

The mean difference between the auriculocephalic distances of the right and left ears was found to be less than 3 mm in both groups. There was no statistically significant difference between the groups in term of symmetry when comparing the ears with the opposite side. This result may be due to the use of the same technique in both right and left ears, and the similar cartilage memory and behavior.

In both groups, VAS scores were significantly increased at the 6th month after surgery, while no significant differences were observed in VAS results between groups at pre-operative and 6 months after the surgery, separately. Although, according to the auriculocephalic distances as the objective criteria, Group 2 had better results to maintain the desired antihelical shape, it did not affect the level of patient satisfaction.

The GAIS was improved in 90.9% and no change in 9.1% of ears in Group 1 and improved in 95.7% and no change in 4.3% of ears in Group 2. No patient was rated as "worse" in both groups. No significant difference was observed between GAIS values of Group 1 and Group 2. In previous publications, the satisfaction rates were higher in patients than in surgeons, but in the present study, the satisfaction rates are very close together in both groups [27].

The recurrence rate was reported to be between 0 and 12% in the literature [28, 29]. Recurrence was observed in 4 ears (9.1%) in Group 1, and in 2 ears (4.3%) in Group 2. The reason for the higher recurrence rate in Group 1 may be due to the higher resistance on sutures because of the cartilage memory. In Group 2, the partial release of the internal self-locked stress system on one side by scoring may reduce the resistance on the sutures and help prevent the cartilage tending toward its first position.

In the literature, the complication rates after otoplasty are between 0 and 47% [28]. In incisionless otoplasty procedures, complications such as scar and keloid formation of the skin incision are not expected. Infection was reported to be between 0 and 15.5% [28, 30, 31]. In our study, infection occurred in 1 patient (2.3%) in Group 1, and this patient recovered with appropriate medical therapy. Trenite reported a visible sharp edge and contour deformities resulting from a too deep incision while cartilage scoring [23]. In our study, hemorrhage, keloid formations, hematomas, and sharp contours or irregularities did not occur in any patient of the two groups.

According to our results, comparison of these two groups showed that patient satisfaction was also good in both. The operation time was a little shorter in Group 1 (without scoring). The auriculocephalic distances, as the objective criteria, at the 4th week after surgery and at the 6th month after surgery were higher in Group 1. The recurrence rate was lower in Group 2 (with scoring). The suture extrusion rate was lower in Group 2. GAIS and VAS values, as subjective criteria, similarly improved in both groups.

Although there was a significant difference of 1–2 mm in auriculocephalic distances, our study showed that cartilage scoring is not a 'must' to correct prominent ears in pediatric patients with soft cartilages in order to achieve patient and surgeon satisfaction.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Adana Numune Training and Research Hospital report no: 91.

Informed Consent: Written informed consent was obtained from the parents of the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.H., G.K.; Design - S.H., O.K.A.; Supervision - İ.Y., O.K.A.; Resources - S.H., T.G.H.; Materials - S.H.; Data Collection and/or Processing - S.H., T.G.H.; Analysis and/or Interpretation - G.K., İ.Y.; Literature Search - G.K., T.G.H.; Writing Manuscript - S.H., T.G.H.; Critical Review - İ.Y., O.K.A.

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REFERENCES

1. Janis JE, Rohrich RJ, Gutowski KA . Otoplasty. Plast Reconstr Surg 2005; 115: 60-72. [CrossRef]
2. Adamson PA, Strecker HD. Otoplasty techniques. Facial Plast Surg 1995; 11: 284-300. [CrossRef]
3. Macgregor FC. Ear deformities: social and psychological implications. Clin Plast Surg 1978; 5: 347-50.
4. Bradbury ET, Hewison J, Timmons MJ. Psychological and social outcome of prominent ear correction in children. Br J Plast Surg 1992; 45: 97-100. [CrossRef]
5. Maniglia AJ, Maniglia JV. Congenital lop ear deformity. Otolaryngol Clin North Am 1981; 14: 83-93.
6. Balogh B, Millesi H. Are growth alterations a consequence of surgery for prominent ears? Plast Reconstr Surg 1992; 89: 623-30. [CrossRef]

7. Becker DG, Lai SS, Wise JB, Steiger JD. Analysis in otoplasty. Facial Plast Surg Clin North Am 2006; 14: 63-71. [CrossRef]
8. Adamson PA, Strecker HD. Otoplasty techniques. Facial Plast Surg Clin North Am 2006; 14: 79-87. [CrossRef]
9. Yugueros P, Friedland JA. Otoplasty. The experience of 100 consecutive patients. Plast Reconstr Surg 2001; 108: 1045-53. [CrossRef]
10. Gibson T, Davis W. The distortion of autogenous cartilage grafts: its cause and prevention. Br J Plast Surg 1958; 10: 257. [CrossRef]
11. Stenstrom SJ. A "natural" technique for correction of congenitally prominent ears. Plast Reconstr Surg 1963; 32: 509-18. [CrossRef]
12. Chongchet V. A method of antihelix reconstruction. Br J Plast Surg 1963; 16: 268-72. [CrossRef]
13. Mahler D. The correction of the prominent ear. Aesthetic Plast Surg 1986; 10: 29-33. [CrossRef]
14. Raunig H. Antihelix plasty without modeling sutures. Arch Facial Plast Surg. 2005; 7: 334-41. [CrossRef]
15. Tan O, Atik B, Karaca C, Barutcu A. A new instrument as cartilage scorer for otoplasty and septoplasty: Adson-Brown forceps. Plast Reconstr Surg 2005; 115: 671-2. [CrossRef]
16. Mustarde´ JC. The treatment of prominent ears by buried mattress sutures: a ten-year survey. Plast Reconstr Surg 1967; 39: 382-6. [CrossRef]
17. Fritsch MH. Incisionless otoplasty.Laryngoscope 1995; 105: 1-11. [CrossRef]
18. Ozturan O, Dogan R, Eren SB, Aksoy F, Veyseller B. Percutaneous adjustable closed otoplasty for prominent ear deformity. J Craniofac Surg 2013; 24: 398-404. [CrossRef]
19. Haytoglu S, Haytoglu TG, Yildirim I, Arikan OK. A modification of incisionless otoplasty for correcting the prominent ear deformity. Eur Arch Otorhinolaryngol 2015; 272: 3425-30. [CrossRef]
20. Haytoglu S, Haytoglu TG, Bayar Muluk N, Kuran G, Arikan OK. Comparison of two incisionless otoplasty techniques for prominent ears in children. Int J Pediatr Otorhinolaryngol 2015; 79: 504-10. [CrossRef]
21. Mandal A, Bahia H, Ahmad T, Stewart KJ. Comparison of cartilage scoring and cartilage sparing otoplasty: A study of 203 cases. J Plast Reconstr Aesthet Surg 2006; 59: 1170-6. [CrossRef]
22. Foustanos A, Messinis L, Panagiotopoulos K. Comparison of otoplasty results using different types of suturing techniques. Acta Chir Plast 2012; 54: 3-7.
23. Nolst Trenité GJ. Otoplasty: a modified anterior scoring technique. Facial Plast Surg 2004; 20: 277-85. [CrossRef]
24. Caouette-Laberge L, Guay N, Bortoluzzi P, Belleville C. Otoplasty: anterior scoring technique and results in 500 cases. Plast Reconstr Surg 2000; 105: 504-15. [CrossRef]
25. Ito I, Imada M, Ikeda M, Sueno K, Arikuni T, Kida A. A morphological study of age changes in adult human auricular cartilage with special emphasis on elastic fibers. Laryngoscope 2001; 111: 881-6. [CrossRef]
26. Naumann A. Otoplasty: Techniques, characteristics and risks. GMS Curr Top Otorhinolaryngol Head Neck Surg 2007; 6: Doc04.
27. Richards SD, Jebreel A, Capper R. Otoplasty: a review of the surgical technique. Clin Otolaryngol 2005; 30: 2-8. [CrossRef]
28. Limandjaja GC, Breugem CC, Mink van der Molen AB, Kon M. Complications of otoplasty: a literature review. J Plast Reconstr Aesthet Surg 2009; 62: 19-27. [CrossRef]
29. Weerda H, Siegert R. Complications in otoplastic surgery and their treatment. Facial Plast Surg 1994; 10: 287-97. [CrossRef]
30. Tan KH. Long-term survey of prominent ear surgery: a comparison of two methods. Br J Plast Surg 1986; 39: 270-3. [CrossRef]
31. Yousef K. Shabana YK, Ghonim MR, Kamal E, El Morshedy N. Otoplasty: Incisionless Suture Versus Open Technique. J Int Adv Otol 2013; 9: 368-71.