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Comparing Thermoplastic and Non-Thermoplastic Splints and Dexamethasone for Rhinoplasty Swelling Reduction

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Abstract

Objectives: The study aimed to determine the importance of using thermoplastic splinting versus non-thermoplastic splinting in protecting nose external structures post-surgery, particularly swelling effects, using a post-rhinoplastic scoring system ranging from 0 to 4, considering factors like dexamethasone IV administration.

Methods: Between 2019 and 2023, a retrospective study at Hashemite University in Zarqa, Jordan, examined patients who had different types of rhinoplastic surgery. The study excluded patients with previous maxillofacial interventions, cardiovascular or coagulopathy disorders, or high blood pressure. Patients were categorized into two groups based on whether they had thermoplastic splints put on after rhinoplasty. The study used a chi-square test to compare the distribution rates of independent

variables across the groups. The study examined the statistical link between the amount of dexamethasone given intravenously before surgery and patients' post-procedural swelling.A multiple logistic regression analysis and one-way multivariate analysis of covariance were conducted to revealed the clinical significance of adopting thermoplastic splinting over non-thermoplastic strategy in reducing the post rhinoplastic complications of particular swelling while accounting for the cumulative perioperatively administered dexamethasone IV.

Results:A study involving 269 patients found that 45.35% of patients underwent rhinoplastic surgery without TP splinting, while 54.65% underwent TP splinting. The study included 143 women (53.2%) and 126 men (468.8%). The rates of bruising and swelling after surgery were similar between groups. However, there was no significant difference in periorbital ecchymosis scores between groups. The study also found no significant difference in comorbidity burden between the two groups. The study also found no significant difference in the percentage of obese patients based on their body mass indexes.A study examining the impact of tranexamic acid (TP) and multivitamins (MVs) on ecchymosis and swelling after nose plastic surgery found no significant difference between non-TP and TP groups. The study also found no significant difference in the rates of regular MVs supplementation. The researchers used a receiver operating characteristic (ROC) curve to analyze the effect of ∑Dex IV on swelling risk. The results showed that a swelling score of >1 had clinically useful results, while a score of 3 had significant clinical utility.

Conclusion: The one-way multivariate analysis of covariance and the multiple logistic regression analysis show that using thermoplastic splinting instead of non-thermoplastic splinting significantly reduced the risk of swelling after rhinoplasty. According to this study, using thermoplastic splinting may be a good idea. It could be an effective clinical addition to corticosteroid therapy to reduce swelling after rhinoplasty and provide long-lasting positive aesthetic effects.

Keywords: Thermoplastic, Non-thermoplastic, Rhinoplastic, Splinting, Dexamethasone, Swelling complications.

INTRODUCTION

People often get rhinoplasty as a cosmetic procedure, but it is hard to do and can have complications and side effects. It does two things: it keeps or improves nasal function, which is especially helpful for people who have trouble breathing because of blockages. Asian people are more likely to have rhinoplasty surgeries. Problems that happen a lot include bleeding, swollen eyelids, and bruises. Osteotomies, which change the shape of bones surgically, can cause problems during and after surgery. periorbital ecchymosis and edoema are unavoidable side effects of surgery. They can affect the patient's immediate cosmetic results, their preoperative concerns, their emotional state after surgery, and their pain after surgery, which can lead to postsurgical dissatisfaction syndrome. [1-4]

An important part of most rhinoplasty surgeries is the lateral osteotomy, which has been done in a number of different ways by different surgeons. The tools used for lateral osteotomies are also different and are always getting better and changing. Nasal taping and external splinting can help reduce the unpleasant effects that can be undone after a lateral osteotomy during the recovery period. It has also been looked into how to use corticosteroids, cold packs, head elevation, and osteotomy through the buccal sulcus. The initial fractured position of the lateral nasal bones is one of the most common complaints after a major rhinoplasty. To keep the nose from getting wider and to avoid edoema, more information about therapeutic massage should be given at the time of surgery.[5-8]

Postoperative swelling, edoema, and ecchymosis are major problems that patients with rhinoplasty have to deal with, which means they spend more time away from

meaningful social interactions. These effects can be temporary, like nosebleeds, swollen eyelids, and bruises around the eyes and under the conjunctiva, or they can be more permanent and not so nice to look at, like deformities and asymmetry, or they can be functional, like a blocked nose because the lateral wall has collapsed. Facial plastic surgeons are always looking for new ways to lessen these effects. The periosteum that covers the lateral osteotomy line needs to be protected during these procedures, which is another important issue to think about. In the past, research has only looked at how to keep the periosteum in place during internal osteotomies. Peri-osteal sweeping can move the angular artery away from the osteotomy site in the external perforating approach, which keeps the osteotomy site from getting hurt or bleeding.[9-11]

Thermoplastic rhinoplasty is a way to shape the nose that uses thermoplastic materials that are clean and flexible. This lets the surgeon plan the surgery ahead of time and reduces patient complaints. People who have had cosmetic surgery on their nose often complain of swelling afterward. Swelling can be caused by changes in blood flow, tissue volume, and cell structure. To control swelling, drugs like α-Blocker (Doxazocine), Lasix, steroids, NSAIDs, Heparin, and techniques for drawing blood are used to keep side effects to a minimum and speed up the healing process. As we already said, rhinoplasty can be done for function or for looks, and swelling is a normal part of the recovery process. During the time after surgery, things like sleeping in the wrong position, drinking alcohol, and things in the environment can make the swelling worse. To control swelling, you need to understand and fight these factors. In some cases, thermoplastic nasal bone osteotomies can reduce swelling after surgery, which lets patients get surgery and recover in a reasonable amount of time. That shortens the time it takes for people with edoema problems to get back to their normal lives. Recently made improvements to 3D printing technology may open the door to completely new ways to treat edoema. For example, Erdogan et al. just recently wrote about how custom-printed 3D splints can help with periorbital edoema after rhinoplasty better than thermoplastic splints in the short term.9 These researchers found that using 3D custom external nasal splints instead of traditional thermoplastic splints during the time before and right after surgery significantly reduced periorbital edoema and ecchymosis. Since 2017, our group has been using a similar idea with 3D-printed splints to speed up the healing of post-surgery edoema and improve the shape of the nose. It was the goal of this study to find out if these custom-made splints could help reduce swelling.[12-15]

Treatment sessions are done during office visits one week, two weeks, one month, and three months after surgery, after talking with colleagues who are trained in the specific area. By lessening the damage that these swelling pathways do, the swelling can go down and the patient's satisfaction with the surgery can rise. A drug called dexamethasone is used in plastic surgery to control swelling and pain. It breaks down cells and weakens the immune system while a wound heals locally. It also reduces certain stages of inflammation, which has effects on how glucocorticoids are used. To begin, osteoblastic activity can be slowed down, which lowers the fitness of osteoblasts that are involved in production in the first week after injury, during angiogenesis, and at the end of the remodelling phase. The second thing is that glucocorticoids can slow down the activity of osteoblasts, which can lower the tensile breaking strength of epithelial closures. This can also lengthen the time it takes to fix the integrity of the basement membrane and move and deposit type IV collagen, which is part of the "ground substance and fibres." Dexamethasone is the strongest corticosteroid that can be taken by mouth, so it should only be used with care. Based on our data, dexamethasone does not seem to speed up the healing of swelling after rhinoplasty. Dexamethasone may shorten the length and severity of edoema, ecchymosis, and hematoma formation, and if blood flow is slowed down, it may stop secondary damage from happening.[16-18]

The study's goal was to find out how important it is to protect the external structures of the nose after surgery by using thermoplastic splinting versus non-thermoplastic splinting in lowering the risks of complications after surgery, especially the effects of swelling, as measured by a valid post-rhinoplastic scoring system that ranged from 0 to 4 and took into account other important factors, such as the perioperatively administration of dexamethasone IV.

METHODS AND MATERIALS

Between 2019 and 2023, at Hashemite University in Zarqa, Jordan, an observational, retrospective study that wasn't paid for was done. The study looked at people who were there and had had different types of rhinoplastic surgery. Patients who had revision surgery or previous maxillofacial intervention, a history of cardiovascular or coagulopathy disorders, or high blood pressure that couldn't be controlled were not allowed to take part in the study. Patients younger than 18 or older than 60 years old were also not included in the study, nor were patients who needed an extra osteotomy during surgery for rocker or step deformities on either side. For female patients, they were told to schedule their surgeries for a time after their period.

The Institutional Review Board/Human Subjects Committee of the Faculty of Medicine at Hashemite University gave their approval for this study. Since this study looked at things that happened in the past, informed consent was not needed. The information about the patient was gathered by looking back at hospital records. The patients' demographics, anthropometrics, comorbidity burden (measured by age-adjusted comorbidity index), use of tranexamic acid, dexamethasone, and multivitamins, type of splinting used after rhinoplasty (thermoplastic or non-thermoplastic), scores for complications after the procedure, and the length of the rhinoplasty procedure in minutes were all included. The information about each patient was, in fact, made anonymous and then kept in a safe place.

During the procedure, all of the patients were given nasal packing that wasn't too tight. Also, all of the patients were given instructions for what to do after the surgery. Antibiotics were given to the patients for 5 days, and painkillers were given until the pain was manageable. Also, all of the patients were told to raise their heads. The main result of this study was to look at periorbital swelling after surgery. The periorbital swelling was graded using a system created by Kara et al. [18-19]. A score of 0 means there is no swelling, a score of 1 means the iris is barely covered, a score of 2 means the iris is fully covered, a score of 3 means the iris is fully covered, and a score of 4 means the eyelid is closed. **Figure 1** shows how these post-rhinoplastic swelling grading systems work.Before sending the patient home, the primary surgeon checked on them the day after surgery. After that, the patient was checked on at the outpatient clinic seven, fourteen, and twenty-one days after the surgery. The results of the tests that were done at each follow-up appointment after surgery.

The patients who were eligible to be studied were first split into two groups based on whether they had thermoplastic splints put on after rhinoplasty. The first group, called Group I, did not have post-rhinoplastic thermoplastic splinting done. The comparison group, called Group II, did not have post-rhinoplastic thermoplastic splinting, on the other hand. The two groups, which were put into groups based on how they related to thermoplastic (TP), were used as the dependent variable to compare. A chi-square test was used to look at the distribution rates of other independent variables across Groups I and II. The chi-square test was also used to find the odds ratio (if statistically significant), chi-square significance ($\chi 2$ (df)), Pearson correlation, and p-value for each variable that was tested.

After that, we looked at the statistical link between the total amount of dexamethasone given intravenously ($\sum$Dex IV) before surgery in milligrammes and how bad the patients' post-procedural swelling (PRS) was. We looked at this connection at three different levels:

PRS>1, PRS>2, and PRS>3. In the beginning, we thought that patients with PRS scores of 2, 3, or 4 were in a positive state, which we showed as 1. On the other hand, scores of 0–1 were considered negative states and were shown as 0. In the second analysis scenario, a patient's PRS score between 3 and 4 was considered to be in a positive state. Scores between 0 and 2 were considered to be in a negative state. In the third case, a patient's PRS score of 4 was considered a positive state, while scores between 0 and 3 were considered negative states. For each case, we used receiver operating characteristic (ROC) curve analysis to find the area under the ROC curves, as well as their standard error of means (AUROC±SEM) and 95% confidence interval ranges (CI: LL–UL). During sensitivity analysis, we used the series of ∑Dex IV values and the false positive values that went with them to show the other sensitivity indices at the best operating cutoff value. By looking at Youden's J statistic, the best ∑Dex IV was chosen. They were the true positive rate (TPR), which is another name for sensitivity, the true negative rate (TNR), which is another name for specificity, the positive and negative predictive values (PPV and NPV), the negative likelihood ratio (NLR), and the accuracy index (AI).

The goal of the binary logistic regression analysis was to find out how well the ∑Dex IV can predict the chance of swelling after rhinoplasty. We wanted to find the coefficients we needed to make a regression model and look at different performance measures, like accuracy index (AI), positive predictive value (PPV), and negative predictive value (NPV), to figure out how likely it was that someone would get a PRS score. A regression analysis was done to look at the connection between the ∑Dex IV and the chance of PRS>2. A built-in model was used for the analysis, and the chance of PRS>2 was found at a certain cutoff point.

Figure 1. Post-rhinoplastic swelling grading (0-4) system.

This study then added our main comparison group—the non-TP splinting group—along with the TP splinting group—to the previous binary logistic regression. This was done by running a multiple logistic regression analysis that looked at the regressional effect of TP intervention in relation to the ∑Dex IV for predicting the risk of swelling after surgery. Then, the differences that were summed up, the model's performance indicators, and the needed coefficients for the multiple logistic regression analysis were compared to the results from the binary logistic regression analysis, which didn't look at the effects of TP splinting.

We wanted to find out how TP splinting affected the proposed outcomes of studies that looked at the risks of swelling and ecchymosis after surgery, as well as the total time of the procedure in minutes in the presence of covariate effects of ∑Dex IV. To do this, we used a one-way multivariate analysis of covariance (MANCOVA) to compare the effects of using

a post-rhinoplastic thermoplasting splinting strategy versus the old way of doing things, along with the covariate impactful effects (∑Dex IV) in mg.The MANCOVA analysis can be used to get different multivariate statistics that can be used to see if the differences between TP splinting methods are statistically significant. Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root are some of the most important of these multivariate statistics. They do, in fact, all give the p-value of the chance of getting an F-statistic that is greater than or equal to the one that was calculated, but they do it in different ways. They also tell us how big the effect is. It can be hard to choose the right multivariate F-statistic because they don't always give the same result. We actually used Wilks' Lambda (º) in this study because that's the multivariate statistic that most statisticiansprefer to useaccording to the Pituch and Stevens (2016) univariate statistical test follow-up method for the one-way MANCOVA. The statistical significance for using TP splinting over other types of splinting could be found in the "group row" along the "Wilks' Lambda" row. Also, the statistically significant effects on the three variables of interest in this study: the post-rhinoplastic swelling score (0–4), the post-rhinoplastic ecchymosis score (0–4), and the total procedure timeframes in minutes, could be done by doing a post hoc analysis between the subjects' effects.

Microsoft Office LTSC Professional Plus 2021 Excel was used to collect and sort the patient data for this study. For statistical analysis, IBM SPSS Statistics version 25 was used. A significance level of 0.05 was used in this study.

RESULTS

Thermoplastic splints have traditionally been used to help otorhinolaryngologist surgeons effectively manage post-rhinoplastic complications, such as periorbital bruising, eyelid swelling, and nostril adhesions. A total of 269 patients underwent testing and attended appointments for rhinoplasty surgery. Out of the total number of patients who attended, approximately 45.35% (122 patients) underwent rhinoplastic surgery without undergoing post rhinoplastic TP splinting strategy. This group is referred to as Group I. By contrast, around 54.65% (147 patients) underwent post procedural splinting by adopting the non-TP modality (Group II).

A total of 143 women (53.2%) and 126 men (468.8%) took part in this study. There were not statistically significant differences between the rates of men and women in Groups I and II, with 58 (47.5%)males and 64 (52.5%)females compared to 68 (46.3%)males and 79 (53.7%) females ($\chi 2$ (1) =0.044, p-value=0.834). It was found that the odd ratio for gender was 0.95 (95% CI; 0.59-1.54)and the correlation between Groups I and II was -0.013±0.061.

There wasn't a substantial distinction between the age groups of the patients in the non-TP splinting group and the TP splinting group. The highest rate was 55 (45.1%), followed by 35 (28.7%), and 26 (21.3%) versus 62 (42.2%), followed by 47 (32.0%), and 30 (20.4%) for 26–35 years, 18–25 years, and 36–45 years, respectively, ($\chi 2$ (4) = 0.811, p-value = 0.937). The age ranges of these patients were also not significantly and negatively correlated (-0.011±0.061) between Groups I and II.

After having surgery on the nose, 91.8% of people with scores above 2 had bruising and 52.8% had swelling. For scores below or equal to 2, the rates were 8.2% for bruising and 47.2% for swelling. The rates of swelling after surgery on the nose were very different between Group I and Group II. The rates for scores above 2 were 96 (78.7%) in Group I and 46 (31.3%) in Group II. In Group I, 26 people (21.3%) had scores of 2 or less, while in Group II, 101 people (68.7%) did. When the chi-square test was used for statistical analysis, it showed that the difference in rates was statistically significant ($\chi 2$ (1) =60.09 and p-value=0.000). The odds ratio for a higher score in post-rhinoplasty swelling was found to be 0.123 (95% CI: 0.07–0.22) and the correlation was -0.473±0.053.

In our study, however, the statistical analysis showed that there wasn't a big difference between Group I and Group II in the rates of post-rhinoplastic periorbital ecchymosis scores. For scores above 2, 113 (92.6%) of people in Group I had them, while 134 (91.2%) of people in Group II did. Scores less than or equal to 2 were found in 13 (8.8%) of Group II and 9 (7.4%) of Group I. It was 0.191 and the p-value was 0.662 for the chi-square test. In this study, we found that there was a weak (-0.02±70.060) negative correlation between higher ecchymosis scores in patients who had TP splinting after surgery and patients who did not have TP splinting.When examining the differences in comorbidity burden between the two groups undergoing rhinoplastic surgeries, it was determined that there was no statistically significant difference in the age-adjusted Charlson comorbidity index scores ranging from 0 to 6 ($\chi 2$ (6) =4.940, p-value=0.552).

The patients in Test Groups I and II had the same percentage of obese people based on their body mass indexes. In particular, 58 people (47.5%) in Group I had normal body weight indexes, while 75 people (51.0%) in Group II did. Similarly, 64 (52.5%) of the people in Group I were overweight, while only 72 (49.0%) of the people in Group II were overweight. The statistical test showed that this distribution was not important ($\chi 2$ (1) =0.323, p-value=0.570). The odd ratio was found to be 0.87 (95% CI: 0.54–1.41) and the Pearson correlation was -0.035±0.061.

Along with the main study of thermoplastic (TP) for splinting as a way to protect the injury, some of the patients we looked at had also been taking multivitamins (MVs) regularly in the past. During surgery, they were given dexamethasone through an IV, and it could have been given after surgery as well. Regularly taking multivitamins before surgery and giving dexamethasone intravenously before and after surgery may both help reduce the risk of ecchymosis and swelling after plastic surgery on the nose. When it came to ∑Dex IV, there was a statistically insignificant difference between the non-TP and TP groups, with 64 (52.5%) and 58 (47.5%) in the non-administered Dex IV group and 77 (52.4%) and 70 (47.6%) in the administered Dex IV group ($\chi 2$ (1) = 0.000, p-value = 0.990). In the case of regular MVs, the rates were not statistically different between Groups I and II: 60 (49.2%) and 62 (50.8%) vs. 79 (53.7%) and 68 (46.3%) for negative history and positive history of postoperative regular MVs supplementations, respectively ($\chi 2$ (1) = 0.555, p-value = 0.456)

In our study, 134 people (49.8% of those who didn't experience tranexamic acid) used it during surgery, while 135 people (50.2% of those who did) used it during surgery. However, we did not find a statistically significant for the experiencing tranexamic acid IV over non-experiencing tranexamic acid intraoperatively in rhinoplastic surgery patients in Group I-II:63 (51.6%)and 59 (48.4%) vs 72 (49.0%)and 75 (51.0%), $\chi 2$ (1) =0.189, p-value=0.664]. In **Table 1**, you can see the results of the chi-square test on the variables that were studied in two groups: those who had never been through TPA (Group I) and those who had. **Figure 2** shows the bar charts that show the variables being studied in both Groups I and II.

We used a receiver operating characteristic (ROC) curve to look into how the ∑Dex IV affected the risk of swelling after rhinoplasty, and we used three suggested score thresholds. To begin, we looked into the difference between a swelling score of >1 (a positive state, marked as 1) and a score of ≤1 (a negative state, marked as 0). Second, we set a threshold for swelling scores of >2 (positive state, shown as 1) and ≤2 (negative state, shown as 0). Third, we set the threshold for a swelling score to be >3 (positive state, shown as 1) or ≤3 (negative state, shown as 0). In the first case, there were 250 cases in the positive state and only 19 cases in the negative state. It was found that the yielded area under the ROC curve (AUROC) was 0.978±0.008 (95% CI: 0.961-0.994), and the P-value was 0.000. A threshold of 2 for the swelling score also showed clinically useful results at an AUROC±SEM (95% CI; LL-UL) of 00.819±0.028 (95% CI; 0.764–0.874), P-value = 0.000. In the second scenario, there were

142 cases of a positive state and 127 cases of a negative state. It was found that a swelling score of 3 had statistically significant clinical utility at an AUROC±SEM (95% CI; LL-UL) of 0.755±0.039 (95% CI; 0.678–0.832), P-value = 0.000. In the third scenario, there were 251 negative state cases and only 18 positive state cases, which is different from the first scenario. Figure 3 shows the ROC curve analyses for the patients who were given dexamethasone intravenously before the procedure compared to their well-being scores 1, 2, and 3 after the surgery.

Along with ROC curve analyses, we used binary logistic regression and sensitivity analyses to find the right coefficients for building the regressional model. These helped us figure out the range of variability and quality of the predictions, as well as the best Dex IV and its corresponding sensitivity indexes. The predicted changes in the chance of a post-rhinoplastic swelling score >2 instead of ≤2 (the second scenario) based on our model ranged from 30% to 40% depending on whether we used the Cox & Snell R2 or Nagelkerke R2 methods [$\chi 2$ (4) = 38.103, p-value=0.000]. The binary logistic regression model that was made was written as %Prob Swelling>2=e (1.339-0.279×∑Dex IV)/ [1+ e (1.339-0.279×∑Dex IV)]. We found that 7.15 mg of dexamethasone was the best dose for our group of Jordanians. This gave us the best sensitivity, specificity, positive and negative predictive values, negative likelihood ratio, youden and accuracy indexes of 90.8%, 71.65%, 78.18%, 87.50, 12.78%, 62.52%, and 81.78%, respectively. The study found that 34.17% of people who got the optimal ∑Dex IV dose of 7.15 mg had a post-rhinoplastic swelling score of 2 or more. Our built binary logistic regression model showed a slightly lower specificity than the overall estimated specificity (71.65% vs. 72.4%), even though the optimal ∑Dex IV dose of 7.15 mg was used. But the results showed that the sensitivity, positive and negative predictive values, and accuracy index were all higher than what was expected overall [(90.8% vs. 74.6%), (78.18% vs. 75.2%), (87.5% vs. 71.9%), and (81.78% vs. 73.6%), respectively]. **Figure 4** shows an example of binary logistic regression along with its overall and sensitivity indices results.

The main variable we looked at in this study was the post-procedure TP experiencing. We added this to the patients' ∑Dex IV in mg while doing a multiple logistic regression analysis. This gave us a model that explained a slightly higher range of differences in the chance of a post-rhinoplastic swelling score >2. Depending on whether we used the Cox & Snell R2 or Nagelkerke R2 method, this score was anywhere from 49.41% to 66%. Our multiple logistic regression model, which looked like this: %Prob Swelling>2=e (4.564-4.211×TP-0.524×∑Dex IV)/[1+ e (4.564-4.211×TP-0.524×∑Dex IV)]; it showed that using thermoplastic splinting was significantly linked to a lower risk of having a higher swelling risk, with a magnitude ± standard error of -4.211±0.757 or an estimate ratio of 0.015 at a fixed patients' ∑Dex IV in mg before surgery. In the multiple logistic regression analysis compared to the binary logistic regression analysis that was already done, the patients' ∑Dex IV in mg decreased their risk of having more swelling by -0.524±0.090 per mg, while in the binary logistic regression analysis it was -0.279±0.033 per mg. In our model, adding the binary interventional TP splinting strategy made the sensitivity, specificity, positive and negative predictive values, and accuracy index better by 97.9%, 66.1%, 76.4%, 96.6%, and 82.9%, respectively, compared to 74.6%, 72.4%, 75.2%, 71.9%, and 73.6%, when the non-TP splinting strategy was left out. Figure 5 shows the multiple logistic regression example and the results that go with it.

When we conducted the one-way multivariate analysis for covariance (MANCOVA) on the multi-variate dependent variables: post-rhinoplastic swelling (PRS) score (0-4), post-rhinoplastic ecchymosis (PRE) score (0-4), and overall procedural timeframes across our major binary post-postprocedural TP categories: non-TP splinting category (Group I) vs TP

splinting category (Group II) while also accounting for ∑Dex IV perioperatively dosing in mg, we showed in the multivariate results that the introducing TP splinting strategy rather non-TP splinting strategy had statistically significant on the combined investigated three outcomes of interest: PRS score (0-4), PRE score (0-4), and overall procedural timeframes after controlling for the ∑Dex IV, F (1, 264)=157.47, p-value<0.0005, Wilks' Λ = 0.358, partial η2 = 0.642.In which the F indicates that we are comparing to an F-distribution (F-test), 1 in (1, 264) indicates the degree of freedom of Wilk's Lambda for one-way MANCOVA, 264 indicates the degree of freedom for the error term for Wilks' lambda, P<0.0005 indicates the probability of obtaining the observed F-value given the null hypothesis is true, Wilks' Λ=0.358 indicates the value of Wilks' lambda, and the partial η2=0.642 refers to the measure of effect size for Wilks' lambda of the adopting the TP splinting modality over than non-TP splinting modality on the patients' clinical outcomes (even though till present there are no agreed upon definitions of what constitutes a strong (or otherwise) effect size). However, If you look at the three dimensions of patients' impacts along with the continuous covariate (patients' adherence rating), you can see that there is a statistically significant difference between the groups of independent variables. When investigated the results' between-subjects effects, we revealed that the adopting TP splinting strategy rather than non-TP modality had statistically significant only on the PRS score (0-4) [F (1, 30.953) =238.16, p<0.0005, partial Eta Squared=0.472], while it is insignificant for both dependent variates: PRE score (0-4) and overall procedural timeframe in minutes [F (1, 0.018)=0.051, p-value=0.822, partial Eta square=0.000] and [F (1, 13.488)=0.358, p-value=0.550, partial Eta square=0.001], respectively.**Tables 3-4** present the conducted One-way multivariate analysis for covariance on the swelling, ecchymosis, and procedural timeframes across TP groups while accounting for Dex IV Post-hoc analysis of the one-way multivariate analysis for covariance results between-Subjects Effects, respectively.

DISCUSSION

The study is mainly about immobilising the nasal area with splints made of modern materials like thermoplastic compounds in people who have had rhinoplasty. One of the best things about thermoplastic splints is how easy they are to use. This is because they are easy to shape while being exposed to high temperatures. The complex structure of thermoplastic splints is made up of different types of polymers. The properties of each product depend on how the chemicals are linked and how much they are cross-linked. In orthopaedics, thermoplastic splints are often used to treat different types of fractures and have been shown to be effective in improving radiological outcomes. It has been shown for more than 30 years that thermoplastic principles can be used in medicine. New generations of thermoplastic splints have impressive properties that make them the standard for immobilising patients after surgery. How well the splinting works depends a lot on the materials that are used and how skilled the surgeon is. Based on the use of thermoplastic materials in many areas, such as construction, automotive, electronics, petrochemistry, consumer goods, and many medical areas, such as orthopaedics and otorhinolaryngology, new thermoplastic materials have been created.[21-24]

Our study's main goal was to investigate the differences between using thermoplastic splints and traditional splints for immobilisation in people who have had rhinoplasty and are also dealing with other factors that might affect the post-rhinoplastic complications. In this case, we were interested in the eyelid swelling, which was measured by the post-rhinoplastic swelling (PRS) score (0–4). Here are some possible interacting factors that might affect the clinical outcomes of choosing post-procedure TP splinting over non-TP methods. These include, but are not limited to, giving corticosteroids, especially dexamethasone, before surgery, taking multivitamins with or without minerals (MVs), and giving tranexamic acid

(TXA IV) during surgery to break down fibrin. This study was mostly about the possible effects of cumulative dosing of dexamethasone that was given before surgery on reducing post-operative swelling as shown by the valid scoring system PRS score (0–4) in Jordanian patients who had rhinoplasty. Post-operative swelling is an unavoidable part of the surgery process.

Several studies that compared thermoplastic splints to metallic splints found that thermoplastic splints have many benefits over metallic splints. These benefits include greater modelling capacity, lower risk of asymmetric edoema, postoperative remodelling capacity, lower risk of conjunctivitis, and high safety in cases of facial trauma after surgery. The newest type of thermoplastic splints can also pass through X-rays, which makes them perfect for people who have had serious facial injuries. The polymers used in thermoplastic splints are safe to use, which is another benefit. Also, a lot of research has shown how important biodegradable materials are in the creation of thermoplastic splints. Immobilising the nasal area is an important part of rhinoplasty surgery because it changes the way the nose looks and makes breathing easier. Patients' satisfaction levels, which were tracked in previous studies, may suggest that thermoplastic splints are the best way to immobilise the nose. This is because they offer advantages over traditional immobilisation methods, such as greater modelling capacity, a lower risk of adverse reactions, and a quality-to-price ratio.[25-28]

Glucocorticoids can control and lower inflammation after rhinoplasty in a number of ways, but two of them seem to be more important in this study. They stop polymorphonuclear leukocytes from moving into inflamed tissues or slow down the movement of blood leukocytes into inflamed tissues. As the number of leukocyte margins goes down, they also slow down the laying down of fibrinogen. Glucocorticoids also make the vasoconstrictory effects of adrenaline stronger. When adrenaline and hypotensive anaesthesia were used during rhinoplasty, they strongly stopped the work of surgical hemostasis and plasma fibrinogen from decreasing. It was found that DEX can help reduce swelling after different types of surgery, even when it was given in different ways, at different doses, over longer periods of time, or in different types of studies. Due to the small number of studies, however, the results were less consistent and full. More research needs to be done on other surgical uses for DEX in preventing regional circulation injuries, such as reducing tissue swelling.[29-31]

The study by Bejinariu CG et al. looked at information from 2016 to 2019 about 53 surgeries that patients had. It included two groups of patients who used metal and thermoplastic splints to stay immobile after surgery. People had to be between the ages of 18 and 55, have deformed skeletal bones or changed cartilaginous structures, and agree to the surgical intervention and study after being fully informed about them. The patients' happiness with the looks and function of their new bodies after surgery was measured, with 10 being the highest score. Using thermoplastic splints was more likely to make people happy than using traditional splints. Surgeons had an average experience level of 8.5 (SD=1.14) with thermoplastic splints and 7.72 (SD=1.07) with traditional splints. Finally, thermoplastic splints are better than metallic splints in a number of ways, such as being able to shape better, lowering the risk of asymmetric edoema, and making the patient safer after surgery if they sustain facial trauma.[32]

Erdogan MM et al. did a study to see how edoema and ecchymosis changed with traditional thermoplastic splints and a 3D-printed custom external nasal splint after rhinoplasty. There were two groups of forty people who had open rhinoplasty: the study group used the 3D-printed custom external nasal splint and the control group used the thermoplastic external nasal splint. Before and after the splint was put on, scores for periorbital edoema and ecchymosis were taken. The people in the study group had less ecchymosis and edoema than the people in the control group.... There was a big difference in

the number of cases of ecchymosis between the two groups, except for the hour after surgery and the seventh day after surgery. There was a big difference in the grade of edoema only in the first and fourth hours after surgery. The research shows that 3D printers can now make new thermoplastic splints that can support osteotomy lines and the area around the eye.[33]

Dexamethasone According to Mehdizadeh M et al., tranexamic acid and decreased periorbital edoema and ecchymosis in 60 patients who had primary open rhinoplasty. There were four groups of patients: D, T, DT, and P. The drugs were injected into a vein an hour before surgery and three times every eight hours afterward. Digital pictures were taken on the first, third, and seventh days after surgery. Groups D, T, and DT had much lower ratings for periorbital edoema and ecchymosis compared to the control group. These groups didn't really help stop or lessen periorbital edoema or ecchymosis. Tranexamic acid and dexamethasone both decreased periorbital edoema and ecchymosis in open rhinoplasty in the same way.[34]

A study by Ong AA et al. looked at ways to lower edoema and ecchymosis after rhinoplasty surgery. A systematic review of 50 articles looked at corticosteroids, other drugs and herbal supplements, bleeding during surgery, interventions after surgery, and surgical techniques. It was agreed that nasal packing and periosteal elevation before osteotomy make edoema and ecchymosis worse, while steroids, low blood pressure during surgery, cooling, and elevating the head after surgery make them better. The review suggests that herbal supplements can be used with little risk to the patient. However, more research is needed before an external or internal lateral osteotomy approach can be suggested. The results show that more research is needed before recommending either an external or an internal lateral osteotomy.[35]

A study by Patel A et al. compared traditional taping and 3D-printed nasal splints after rhinoplasty. They found that traditional taping can make patients and surgeons unhappy and temporarily hide the results. Taping and 3D-printed splinting were used on patients in the study. Patients either put steri-strips on the back and tip of the nose or used 3D-printed splints that were made from simulations of the nose. At different times, the total nose, the dorsum, and the nasal tip's percentage change in volume (cm3) was found. When nasal tape was used at different times, the volume dropped by 4.8%, 9.9%, 10.0%, 10.3%, and 10.6%. 3D splints, on the other hand, caused much less swelling of the whole nose at 6 months and 1 year, as well as steady decreases in the tip and dorsum. According to the study, customised 3D-printed splints are a good alternative to traditional taping for reducing swelling after rhinoplasty.[36]

The goal of the study by Ozucer B et al. was to find out how postrhinoplasty taping (PRT) affected nasal edoema and nasal draping in 57 people who had rhinoplasty. The patients were split into three groups: a control group, two groups of patients, and a patient group. The control group did not receive PRT after the external packing was removed. During the allotted time, the patients in the PRT groups got more taping. At the end of weeks 1, 3, and 5, as well as month 6, measurements of MNST were taken after surgery. The results showed that the upper tip changed a lot after 4 weeks of PRT. The tip changed a lot after 2 weeks and 4 weeks of PRT as well. It didn't have a big effect on the tip. Taping after rhinoplasty didn't help people with light skin. On the other hand, it had a big impact on the MNST and the rhinion, but not on the tip or supratip. The study found that PRT helps the skin envelope compress to the underlying framework and lowers postoperative edoema. This is especially true for patients with thick skin, for whom skin draping and nasal refinement are very important to the success of the surgery. The procedure can be especially helpful for people with thick skin, since skin draping and nasal refinement are important for the success of the surgery.[37]

The purpose of the study by Nocini R et al. is to look at complications that happened during surgery in patients who had open rhinoseptoplasty and were treated according to a standard protocol in our department. Between 2017 and 2022, 129 people had rhinoplasty, and 73% said they had mild or no problems. The most common complaint was that the scar wasn't healing properly. This was followed by edoema, nasal dyspnea, infection, and bleeding. There were no reports of serious problems. The protocol seems to work at reducing problems like infection and bleeding, but it's hard to compare it to another research.[38]

The purpose of this retrospective study was to look at how using thermoplastic splinting after surgery might have better clinical benefits in lowering the risks of complications after rhinoplasties, especially periorbital swelling, as shown by a lower chance of scoring this condition, and how these outcomes might be affected by giving dexamethasone intravenously before surgery. In this study, however, we found that giving dexamethasone IV over a period of time before surgery had statistically significant clinical benefits for patients whose chances of selling were greater than 1, 2, or 3. And this cumulative dose of 7.15 mg of dexamethasone per patient per procedure worked best for the group of Jordanians we studied. In this study, we also showed that using thermoplastic splinting instead of non-thermoplastic splinting had a big effect on the patients' health and led to better performance scores. Additionally, when we compared the three dependent variables of post-rhinoplastic swelling, post-rhinoplastic ecchymosis, and the overall procedure times across our main investigated interventional modalities (thermoplastic vs. non-thermoplastic) while taking into account the cumulative dose of dexamethasone given intraoperatively, we saw that the thermoplasting splinting strategy had the only significant effect on the post-rhinoplastic swelling score. Our study makes a number of strong points. The study first looks at a big problem in the field of rhinoplasty: how to reduce nasal swelling after surgery. This is something that both surgeons and patients worry about. Second, the study included 269 patients, which is a pretty big sample size for our Jordanian institutions. This makes the results more statistically valid and easier to apply to other places. Lastly, the fact that patients who received thermoplastic nasal splints had a lot less swelling after surgery suggests that they may have a better recovery and be happier with their care, which has practical implications for surgery. However, our results should be taken with a grain of salt because they have some flaws. First, the retrospective design could introduce biases or make it harder to find links between events. More solid evidence would come from prospective studies. Second, the fact that the study was only done in one centre might make it harder to apply the results to a larger group of people. A more representative sample might come from studies that use more than one centre. The study doesn't look at the long-term effects of different nasal splints or how satisfied patients are with their care after surgery. With long-term follow-up, you might learn useful things. Future longitudinal studies are needed to look into the long-term effects of different nasal splints, such as how satisfied patients are with them and how they look after a long time.

CONCLUSION

The one-way multivariate analysis of covariance and the multiple logistic regression analysis show that using thermoplastic splinting instead of non-thermoplastic splinting significantly reduced the risk of swelling after rhinoplasty. According to this study, using thermoplastic splinting may be a good idea. It could be an effective clinical addition to corticosteroid therapy to reduce swelling after rhinoplasty and provide long-lasting positive aesthetic effects.

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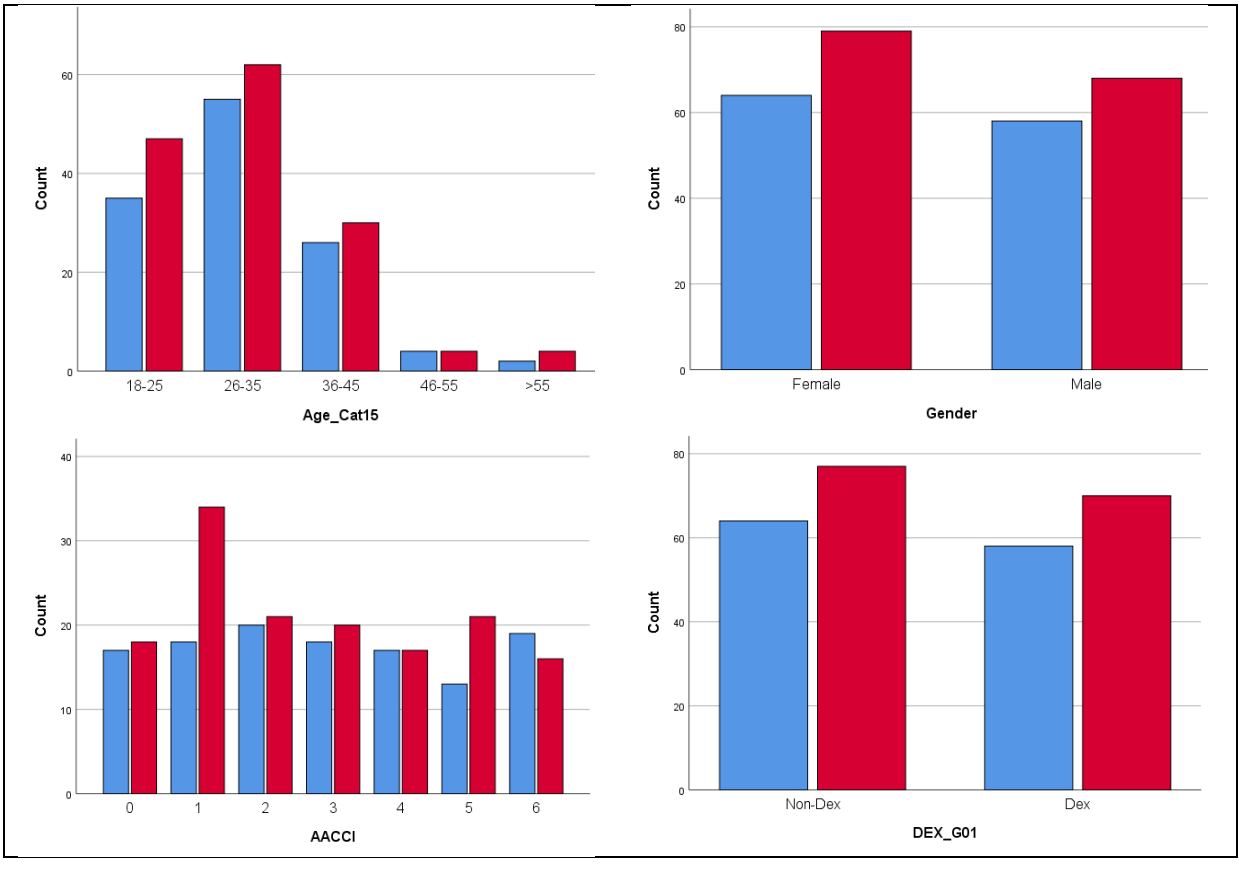
Table 1. Chi square analyses result across non-thermoplastic and thermoplastic splints' groups.

	Non-TP Splint Group I n==122 (45.35%)	TP Splint Group II n=147 (54.65%)	Overall Cohort 269	Odd Ratio	$\chi 2$ (df) p-Value	R±SEV
Age (Years)						
18-25	35 (28.7%)	47 (32.0%)	82 (30.5%)			
26-35	55 (45.1%)	62 (42.2%)	117 (43.5%)	NA	0.811 (4) 0.937	-0.011±0.061
36-45	26 (21.3%)	30 (20.4%)	56 (20.8%)			
46-55	4 (3.3%)	4 (2.7%)	8 (3.0%)			
>55-60	2 (1.6%)	4 (2.7%)	6 (2.2%)			
Gender						
Female	64 (52.5%)	79 (53.7%)	143 (53.2%)	0.95 (95% CI; 0.59-1.54)	0.044 (1) 0.834	-0.013±0.061
Male	58 (47.5%)	68 (46.3%)	126 (46.8%)			
AACCI						
0	17 (13.9%)	18 (12.2%)	35 (13.0%)			
1	18 (14.8%)	34 (23.1%)	52 (19.3%)			
2	20 (16.4%)	21 (14.3%)	41 (15.2%)			
3	18(14.8%)	20 (13.6%)	38 (14.1%)	NA	4.940 (6) 0.552	-0.047±0.061
4	17 (13.9%)	17 (11.6%)	34 (12.6%)			
5	13 (10.7%)	21 (14.3%)	34 (12.6%)			
6	19 (15.6%)	16 (10.9%)	35 (13.0%)			
Dex						
No	64 (52.5%)	77 (52.4%)	141 (52.4%)	1.003 (95% CI; 0.62-1.62)	0.000 (1) 0.990	0.001±0.061
Yes	58 (47.5%)	70 (47.6%)	128 (47.6%)			
MVs						
No	60 (49.2%)	79 (53.7%)	139 (51.7%)	0.833 (95% CI; 0.52-1.35)	0.555 (1) 0.456	-0.045±0.061
Yes	62 (50.8%)	68 (46.3%)	130 (48.3%)			
Obs statues						
No	58 (47.5%)	75 (51.0%)	133 (49.4%)	0.87 (95% CI; 0.54-1.41)	0.323 (1) 0.570	-0.035±0.061
Yes	64	72	136			

	(52.5%)	(49.0%)	(50.6%)				
Swelling Score							
0-2	26 (21.3%)	101 (68.7%)	127(47.2%)	0.123 (95% CI; 0.07-0.22)		60.093 (1) 0.000	-0.473±0.053
3-4	96 (78.7%)	46 (31.3%)	142(52.8%)				
TXA IV							
No	59 (48.4%)	75 (51.0%)	134 (49.8%)	0.899 (95% CI; 0.56-1.45)		0.189 (1) 0.664	-0.026±0.061
Yes	63 (51.6%)	72 (49.0%)	135 (50.2%)				
Ecchymosis Score							
0-2	9 (7.4%)	13 (8.8%)	22 (8.2%)	0.821 (95% CI; 0.34-1.99)		0.191 (1) 0.662	-0.02±70.060
3-4	113 (92.6%)	134 (91.2%)	247 (91.8%)				

TXA: Tranexamic acid. **MV**s:Multivitamins supplement.
Dex: Dexamethasone. **AACCI:** Age adjusted charlson comorbidity index.
Obs: Obesity statues. **R:** Pearson correlation.
TP: Thermoplastic. **SEV:** Standard error of value



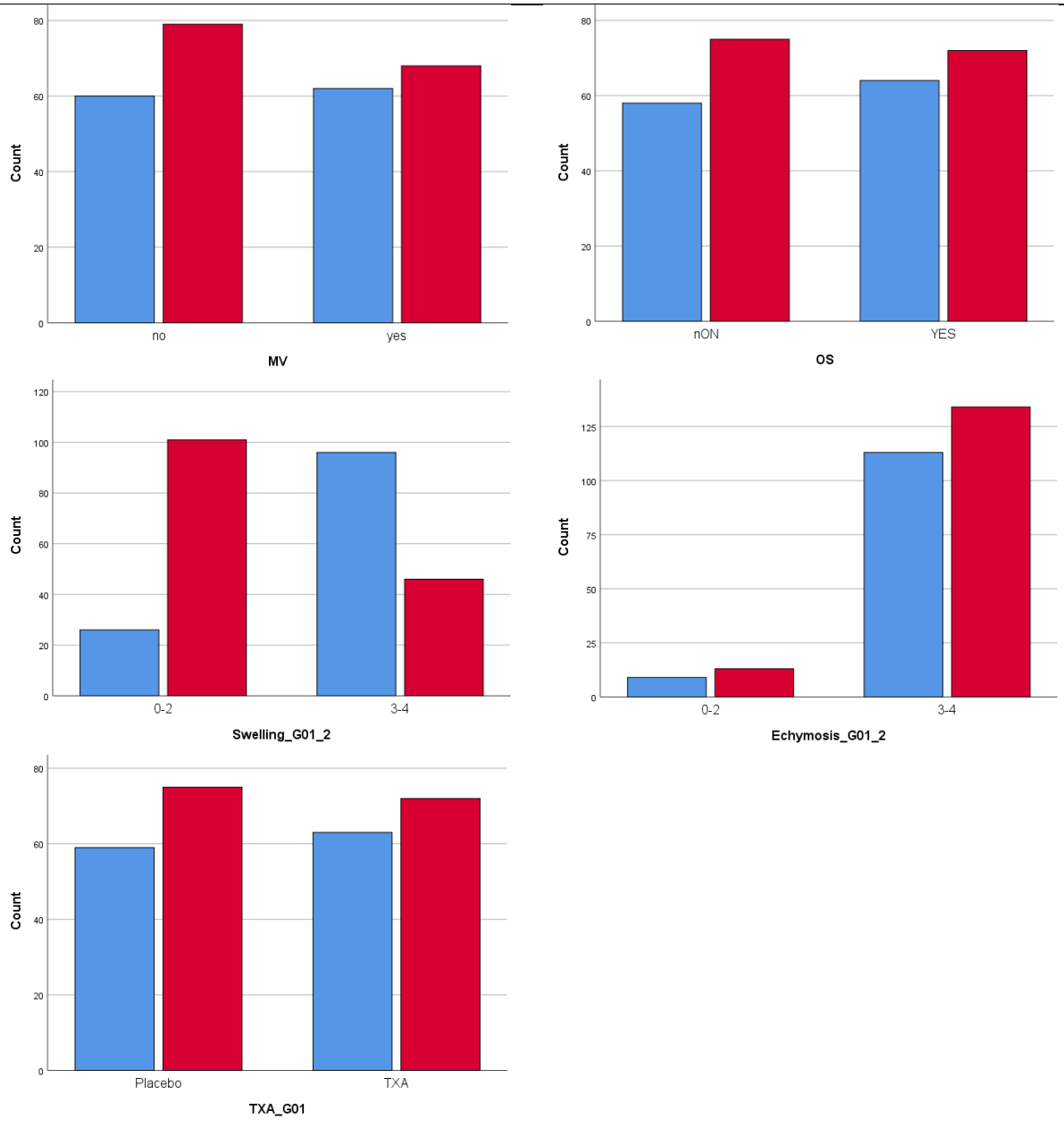
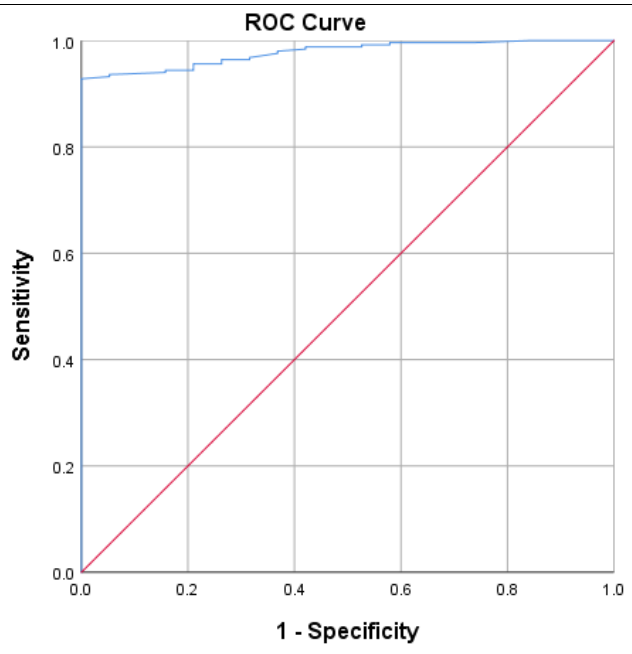


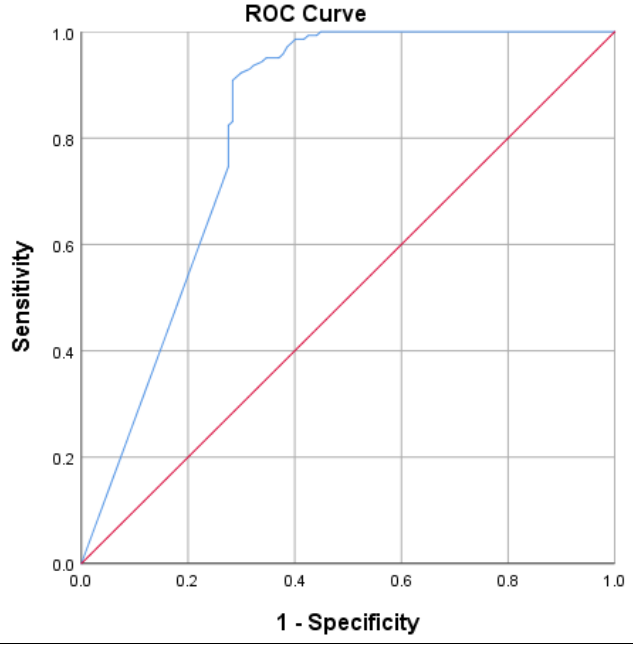
Figure 2. The bar charts illustrate the variables under study in both non-thermoplastic and thermoplastic splints' groups.

TXA: Tranexamic acid.
Dex: Dexamethasone.
Obs: Obesity statues.
TP: Thermoplastic.
MVs:Multivitamins supplement.
AACCI: Age adjusted charlson comorbidity index.
R: Pearson correlation.



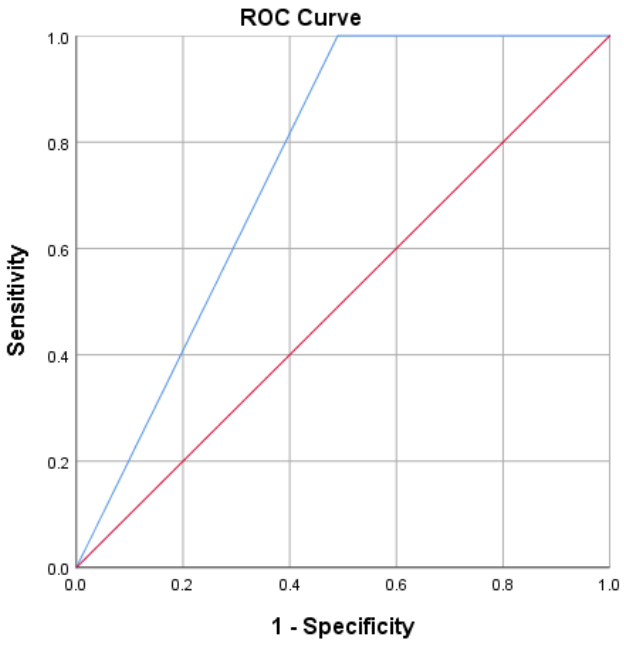
Case Processing Summary	
Swelling score >1 (Positive)	250
Swelling sore ≤ 1 (Negative)	19

AUROC±SEM (95% CI; LL-UL)
0.978±0.008(95% CI; 0.961-0.994)
(P-value=0.000)



Case Processing Summary	
Swelling score >2 (Positive)	142
Swelling sore ≤ 2 (Negative)	127

AUROC±SEM (95% CI; LL-UL)
0.819±0.028 (95% CI; 0.764-0.874)
(P-value=0.000)

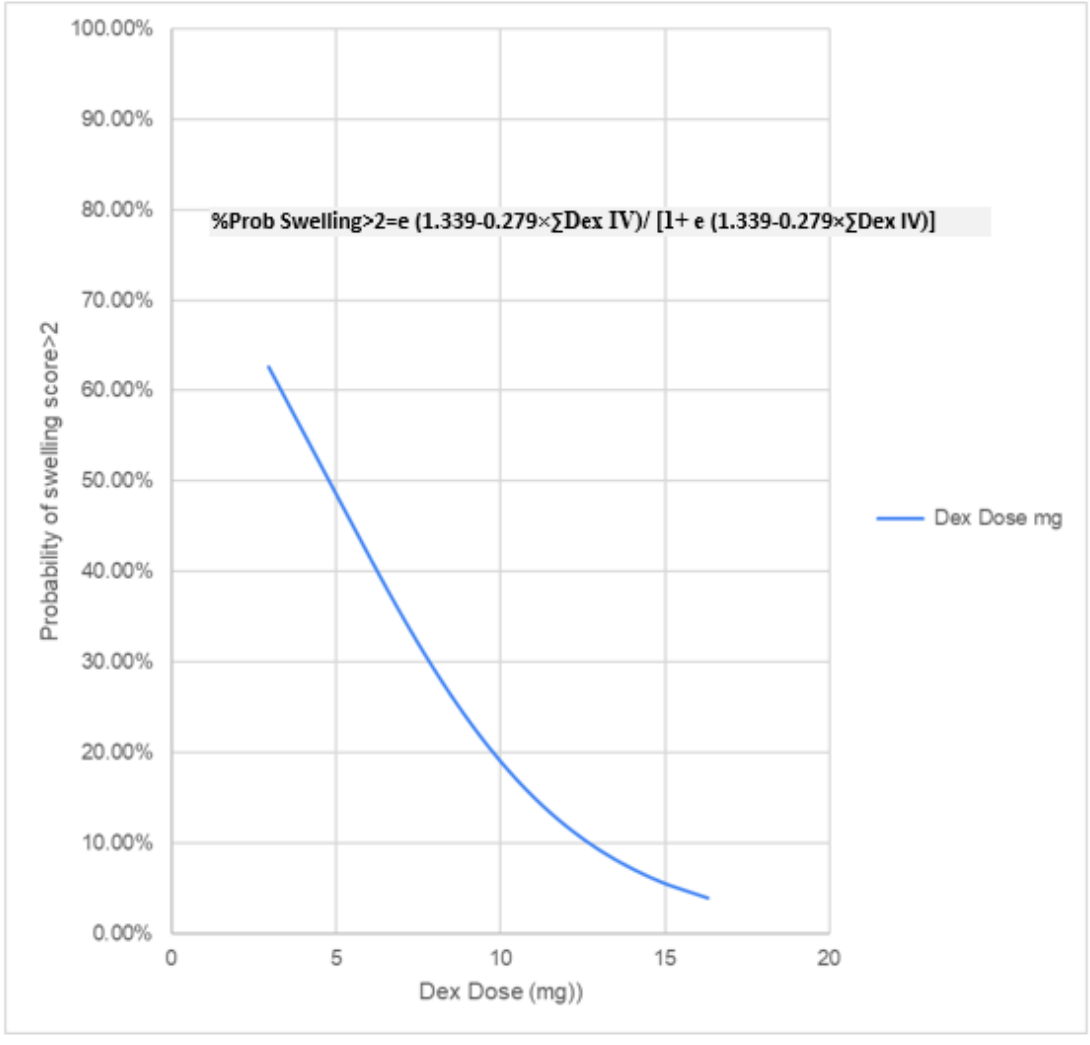


Case Processing Summary	
Swelling score >3(Positive)	18
Swelling sore ≤ 3 (Negative)	251

AUROC±SEM (95% CI; LL-UL)
0.755±0.039 (95% CI;0.678-0.832) (P-value=0.000)

Figure 2. The receiver operating characteristic curve analyses for the studied patients' peri-procedural dexamethasone intravenous against post-rhinoplastic welling scores 1, 2, and 3.

ROC: Receiver operating characteristic
AUROC: Area under the ROC curve
CI: Confidence interval.
SEM: Standard error of mean.
LL: Lower limit.
UL: Upper limit.



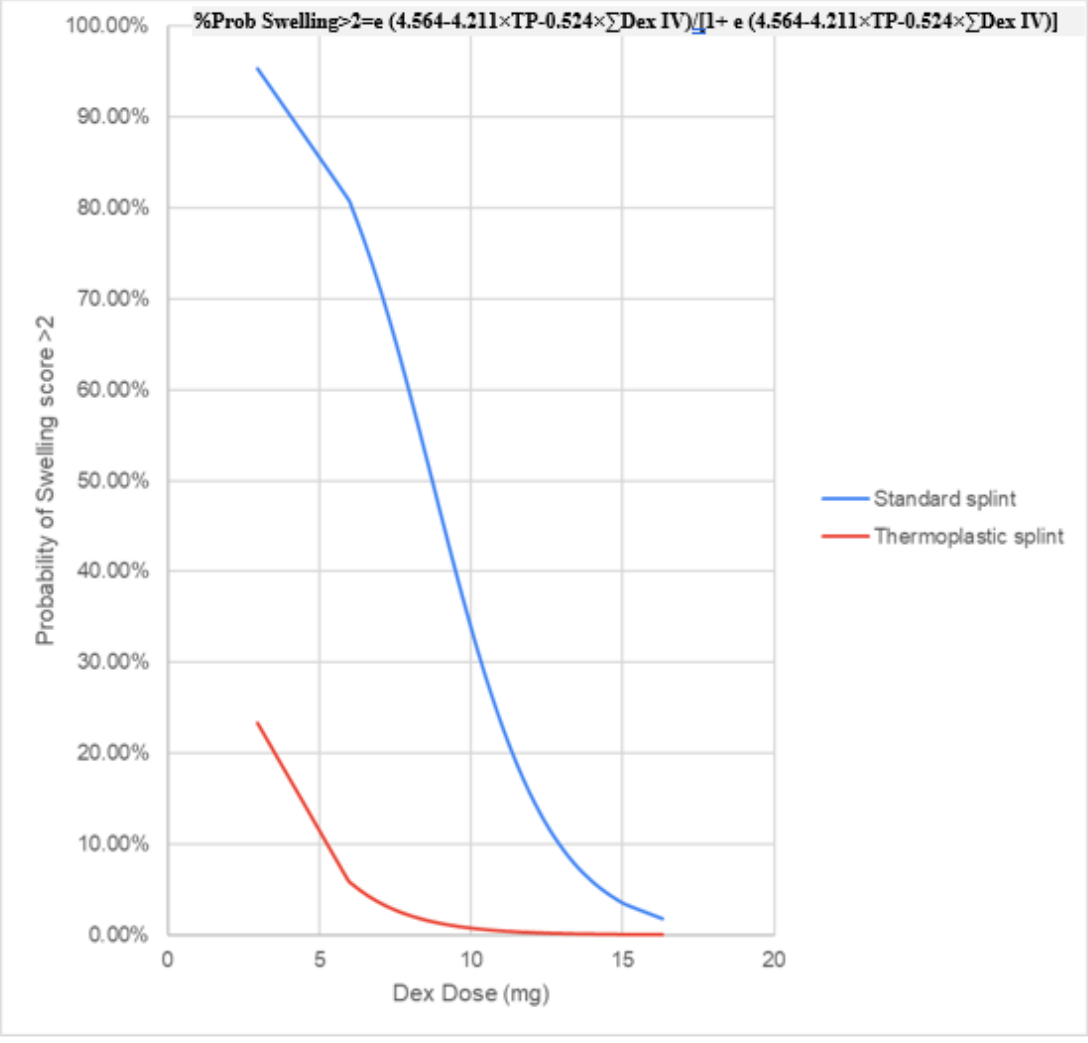
	B±S.E.	Wald	Sig.	Exp(B)	%Var	χ^2 (df) p-value	TPR	TNR	PPV	NPV	AI
∑Dex IV (mg)	-0.279±0.033	71.666	0.000	0.756		38.103					
Constant	1.339±0.203	43.511	0.000	3.816	30%-40%	(4) 0.000	74.6%	72.4%	75.2%	71.9%	73.6%

Cutoff	TPR	YI	TNR	PPV	NPV	NLR	AI	%Prob
7.15	90.8%	62.52%	71.65%	78.18%	87.50	12.78%	81.78%	34.17%

Figure 5. The binary logistic regression illustration with its accompanied overall and sensitivity indices results.

∑Dex: Cumulative dexamethasone.
IV: Intravenous.
EXP (B): Estimate risk.
B: estimated coefficient.
%Var: Variability percentages.
TPR: True positive rate (sensitivity).
TNR: True negative rate (specificity).
PPV: Positive predictive value.
NPV: Negative predictive value.
NLR: Negative likelihood ratio.

%Prob: Probability percentage.	**YI:** Youden's index.
Sig: Statistically significance**.**	**AI:** Accuracy index.
χ2: Chi square.	



	B±S.E.	Wald	Sig.	Exp(B)	%Var	χ2 (df) p-value	TPR	TNR	PPV	NPV	AI
∑Dex IV	-0.524±0.090	33.697	0.000	0.592	49.4%	8.403					
TP (0, 1)	-4.211±0.757	30.931	0.000	0.015	to	(6)	97.9%	66.1%	76.4%	96.6%	82.9%
Constant	4.564±0.750	37.037	0.000	95.927	66%	0.210					

Figure 6. The multiple logistic regression illustration with its accompanied results.

∑Dex: Cumulative dexamethasone.
IV: Intravenous.
EXP (B): Estimate risk.
B: estimated coefficient.
%Var: Variability percentages.
%Prob: Probability percentage.
χ2: Chi square.
TP: Thermoplastic.
TPR: True positive rate (sensitivity).
TNR: True negative rate (specificity).
PPV: Positive predictive value.
NPV: Negative predictive value.
AI: Accuracy index.
Sig: Statistically significance**.**

Table 2. One-way multivariate analysis for covariance on the swelling, ecchymosis, and procedural timeframes across TP groups while accounting for Dex IV

Effect		Value	F	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.994	14136.6	264.000	0.000	0.994
	Wilks' Lambda	0.006	14136.6	264.000	0.000	0.994
	Hotelling's Trace	160.644	14136.6	264.000	0.000	0.994
	Roy's Largest Root	160.644	14136.6	264.000	0.000	0.994
∑Dex IV (mg)	Pillai's Trace	0.646	160.67	264.000	0.000	0.646
	Wilks' Lambda	0.354	160.67	264.000	0.000	0.646
	Hotelling's Trace	1.826	160.67	264.000	0.000	0.646
	Roy's Largest Root	1.826	160.67	264.000	0.000	0.646
TP Splint (0, 1)	Pillai's Trace	0.642	157.47	264.000	0.000	0.642
	Wilks' Lambda	**0.358**	**157.47**	**264.000**	**0.000**	**0.642**
	Hotelling's Trace	1.789	157.471	264.000	0.000	0.642
	Roy's Largest Root	1.789	157.471	264.000	0.000	0.642

∑Dex IV: Cumulative dosing in dexamethasone TP: Thermoplastic.

Table 3. Post-hoc analysis of the one-way multivariate analysis for covariance results between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Swelling	87.38	2	43.689	336.150	0.000	0.717
	Ecchymosis	11.55	2	5.775	16.150	0.000	0.108
	Duration	32.097	2	16.049	0.426	0.653	0.003
Intercept	Swelling	903.45	1	903.448	6951.2	0.000	0.963
	Ecchymosis	1481.91	1	1481.91	4144.3	0.000	0.940
	Duration	1507120	1	1507120	40031.1	0.000	0.993
∑Dex IV (mg)	Swelling	47.89	1	47.89	368.48	0.000	0.581
	Ecchymosis	11.508	1	11.508	32.18	0.000	0.108
	Duration	21.698	1	21.698	0.576	0.448	0.002
TP Splint (0, 1)	Swelling	30.95	1	30.953	238.16	0.000	0.472
	Ecchymosis	0.018	1	0.018	0.051	0.822	0.000
	Duration	13.488	1	13.488	0.358	0.550	0.001
Error	Swelling	34.57	266	0.130			
	Ecchymosis	95.12	266	0.358			
	Duration	10014.6	266	37.649			
Total	Swelling	1254.5	269				
	Ecchymosis	2481.2	269				
	Duration	2724502	269				
Corrected Total	Swelling	121.95	268				
	Ecchymosis	106.67	268				
	Duration	10046.7	268				