Comparative Study Between Absorbable And Non-Absorbable Nasal Packings After Nasal Surgeries

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***Background**: Nasal packing is frequently used after nasal surgeries to control bleeding and prevent adhesions. Many absorbable packing materials have been developed to avoid the drawbacks of the traditional non-absorbable ones and help in wound healing.*

***Objectives**: This study was done to compare between absorbable and non-absorbable nasal packings regarding patient satisfaction and clinical outcome.*

***Patients and methods**: A prospective,single-blinded, randomized controlled clinical study was carried out in Benha University Hospital from May 2018 to November 2019. 40 patients (80 nostrils) were enrolled in this study undergoing surgery. At the end of the procedure, the operative cavity of each patient was randomly packed with Merocel as a non-absorbable material on one side, and an absorbable material, which was sinufoam or gelfoam, on the other side. Patients' symptoms including pain, nasal obstruction and nasal discharge were evaluated with a visual analogue scale. Objective findings about bleeding, crustations, adhesions, infection and mucosal oedema were evaluated endoscopically. Each evaluation was done at 3rd day, 2weeks, 4 weeks, 6 weeks, 12 weeks after surgery.*

***Results:** Absorbable packings had minimal pain, nasal obstruction scores and lower incidence of discharge. Bleeding was significantly higher on absorbable side early postoperative especially with Gelfoam. Crustations and adhesions scores were significantly higher on Merocel packed sides. Gelfoam showed crustations and adhesions more than Sinufoam. Mucosal oedema score was significantly higher in Merocel group than the absorbable. However, there was no difference at 6&12weeks. Gelfoam showed only significantly higher oedema than Sinufoam at 6 weeks. There was a significant difference between absorbable group and Merocel regarding infection at 1&2 weeks. No difference between Gelfoam and Sinufoam regarding infection except at 6 weeks.*

***Conclusion:** Absorbable packings are associated with less discomfort, more bleeding and fewer complications.*

***Abbreviation:** CMC, CT, SMR, FESS,VAS,BS,AS,CS,MES, I&D.*

***Keywords:** Absorbable packings, sinufoam, Gelfoam and nasal surgeries.*

Introduction

Nasal packing materials are generally utilized in various endonasal surgical procedures, including septoplasty, turbinoplasty and paranasal sinus surgeries. Nasal packs are intended to give hemostasis after epistaxis or surgical procedures, support the cartilaginous and bony nasal structure, nasal conchae or soft tissue (for example, sliding flaps) and prevent synechiae or stenosis, particularly following sinus procedures.[1]

Conventional nasal packings incorporate those regularly utilized removable materials like dressing, cotton, and sponge, regardless of whether they are coated by glove fingers or any chemicals.[2] These packings have a few favorable circumstances including availability, modest cost, simple control and adequate supporting capacity. Anyway conventional packings are censured for their different downsides as nasal airway blockage, pressure headache and painful mouth and pharynx dryness because of prolonged mouth breathing. What's more, prolonged packing time may cause infection.[3]

Removal of nasal packs is regularly the most painful part of surgical procedure for patients. pain might be brought about by dislodgement of the blood clot and adherent tissues or following adherence of traditional nasal tampons to the first bleeding site [4]. Also, nasal packing additionally requires a hospital stay and administration of antibiotics and it meddles with nasal physiology. Moreover, packing removal can cause mucosal damage bringing about bleeding. These drawbacks related with removable nasal packings have prompted continuous advancement of biodegradable / absorbable materials not requiring ensuing removal.[6].

There is no commonly perceived standard for which sorts of materials ought to be utilized, howlongs packs ought to stay put, or when indicated, Nasal packs ought to apply pressure, function as a barrier, fill performed spaces, create moist environment to facilitate physiological hemostatic and reparative processes.[1,7]

Sinufoam (ArthroCare) (Stammberger's SinuFoam) is a foam/gel produced using CMC derivative. Carboxymethylcellulose (CMC) can absorb many times its weight in water. In the gel form, it has just been hydrolyzed preceding placement in the nasal cavity. In this way, in spite of the fact that it accomplishes some hemostasis by absorbing water in blood, it basically accomplishes hemostasis by pressure. It likewise gives a moist environment for wound and with its viscosity and thickness, gives a scaffold for epithelialization.[6] CMC is a plant-sourced polysaccharide biomaterial that is an intense activator of the coagulation cascade and is in form of as a mesh, foam, or gel[8].

Aim of the work:

This study was done to compare the efficacy of the absorbable nasal packings (Sinufoam or Gelfoam) and non-absorbable Merocel on wound healing and patient satisfaction.

Patients and Methods

Subjects:

We enrolled 40 patients (80 nostrils) undergoing different nasal surgeries at Benha University Hospital, in a prospective, single-blinded, randomized controlled study between May 2018 and November 2019. **Inclusion criteria** were age between 18 and 45, with deviated septum and /or hypertrophied inferior turbinate, bilateral chronic rhinosinusitis requiring surgery, and a difference of 2 or less

in the **Lund-MacKay** computed tomography (CT) scan. **Exclusion criteria** were history of previous nasal surgery, unilateral disease or massive sinonasal polyposis in patients with rhinosinusitis, and other underlying diseases (diabetic, hypertensive, hepatic, coagulation disorder, immundeficient) that may affect outcomes. **Approval from the Ethical Committee of ENT department, Benha University** was obtained. In addition, informed consent was obtained from all patients before enrollment.

Study design:

As the difference between Sinufoam/ Gelfom and Merocel was obvious, we proceeded as a single blinded study. Patients were randomized to determine which side was to receive absorbable packing (CMC/gelfoam) intraoperatively.The other side received non-absorbable packing (merocel) at the time of procedures. Groups were as follows:

- **Group I: 40** nasal opening with absorbable nasal packing.
- **Group II: 40** nasal opening with non-absorbable nasal packing.

Group I was randomly either :

- **Gelfoam group: 20** patients (20 nasal opening) with Gelfoam on the absorbable side and Merocel on the other side.
- **Sinufoam group**: **20** patients (20 nasal opening) with Sinufoam (Stammberger's SinuFoam) on the absorbable side and Merocel on the other side.

Preoperative evaluation of patients was done through a full history, clinical examinations, nasal endoscopy, radiological and laboratory investigations.

Materials:

SINU-FOAM (Stammberger's SinuFoam) is a CMC-based dressing, begins as a dry carboxymethylcellulose (CMC) fiber inside a syringe. When appropriately blended in with sterile water, the CMC gels to form a viscous dissolvable foam that adjusts to the nasal cavities while giving a moist, hydrocolloid physical barrier. **(Fig 1 (A, B & C)).**

Gelfoam (Pharmacia and Upjohn Company) is porous, water-insoluble hemostatic agent. **(Fig 2 (A & B)).**

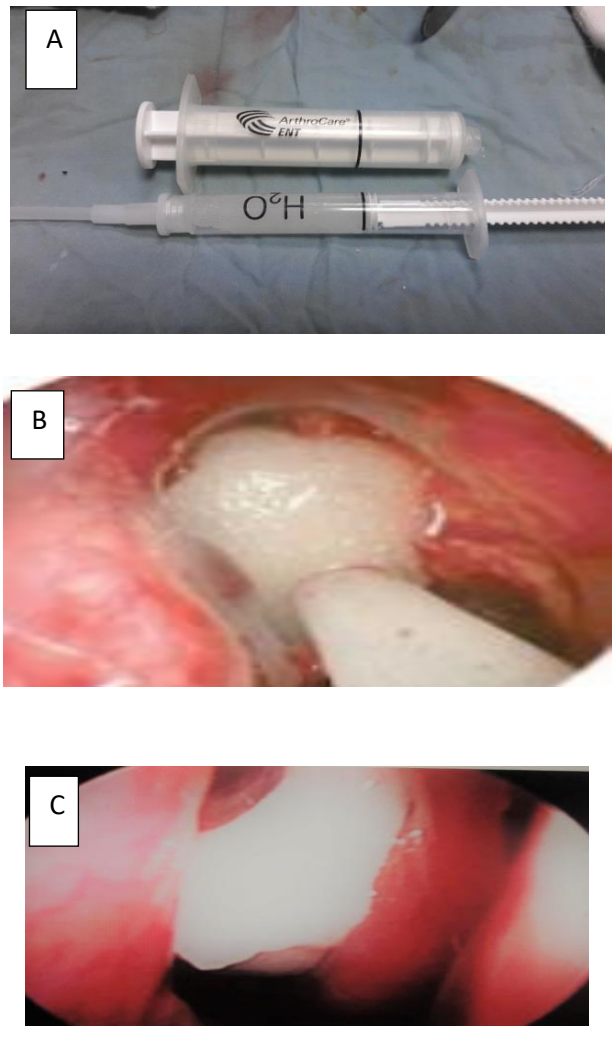

Fig.1:(A) Gross picture of sinufoam gel preparation**. (B)** sinufoam after dissolving during infusion into nasal cavity**. (C)** Endoscopic view of sinufoam in the operative cavity.

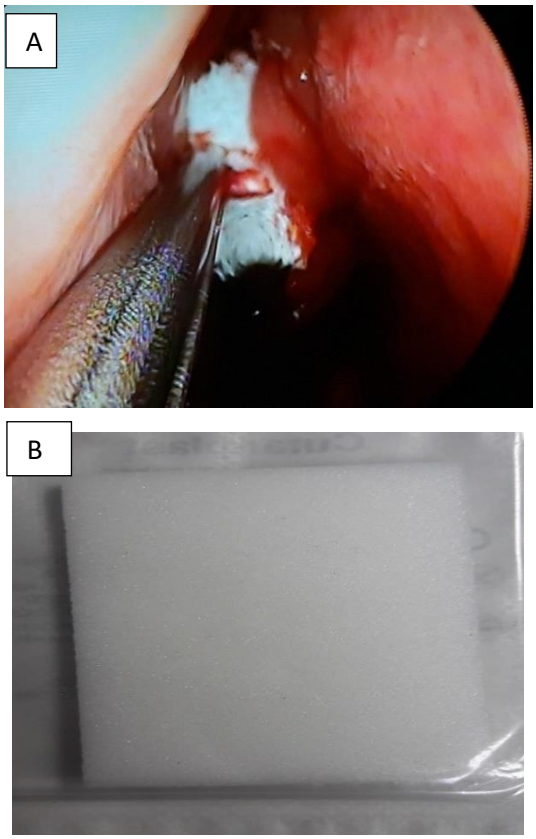

Fig 2 (A) Endoscopic view of gelfoam. **(B)**Gross picture of gelfoam.

Operative procedure:

Patients underwent nasal surgeries including septoplasty (SMR) and/or inferior turbinoplasty or functional endoscopic sinus surgery (FESS).The operative procedures were performed under general anesthesia by senior staff members.

SMR was carried out with resection of most of the deviated cartilagenous and bony septum with or without inferior turbinoplasty. Internal nasal splints were inserted into both nasal cavities and fixed by 3-0 Vicryl sutures.

Surgical procedures of inferior turbinate involved lateralization followed by resection of about half of the posterior part of the turbinate with the aid of an endoscope.

The extent of FESS varied according to the extent of disease and surgeon's individual practice, but usually classic FESS steps was followed.

Postoperative :

All patients received systemic antibiotics (amoxicillin plus clavulinic acid), pain medications, steroids and alkaline nasal wash after pack removal. Removal of packing was at 3rd day after surgery, Merocel was removed entirely. In contrast, the absorbable packing of CMC or Gelfoam was in situ. Remnants of CMC or Gelfoam were suctioned in follow-up visits if were found.

Follow-up assessment:

Patients returned for postoperative visits, we scheduled evaluation before removal of pack, during removal (3rd day), 1week, 2weeks, 4weeks, 6weeks and 12weeks after surgery.

Subjective assessment

Subjective patients' data was acquired using rated symptoms compared between 2 sides. All patients were approached to rate their symptoms on a visual analog scale (VAS) of 0– 10, where '0' signifies no symptoms are present; '10' signifies the most severe symptom. This includes pain, nasal obstruction and nasal discharge. (Fig 3)

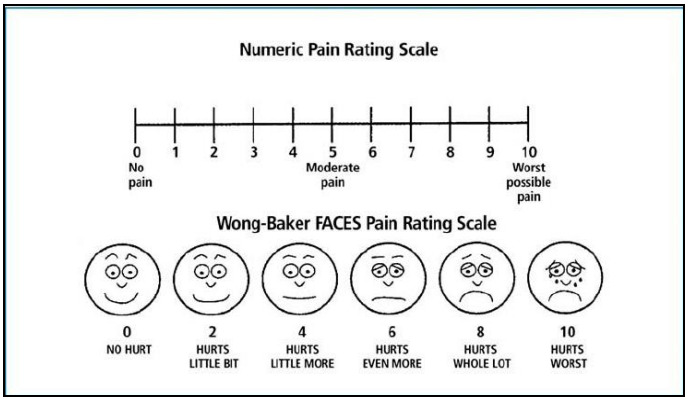

Fig. 3. visual analogue scale (VAS) of pain [10].

Table. 1. Grading scale for subjective assessment

Criteria	score
Pain	
No	0
light	1-4
Moderate	5-6
Intolerable	7-10
Nasal obstruction	
No	0
Mild	1
Moderate	2
Severe	3

Objective assessment:

The patients were evaluated endoscopically after surgery. The operative cavity was evaluated for bleeding, the presence of synechia, crusts, appearance of secretions and appearance of mucosa.

Table. 2A. Grading score for bleeding

score	Criteria
0	No bleeding
1	Minimal (confined to nasal cavity)
2	Moderate (bleeding out of nasal cavity) (cotonoids soaked with phenylephrine hydrochloride)
3	Severe (repacking with merocele)

Table. 2B. Grading score for adhesions

Score	Criteria
0	No
1	Mild (visible,easy to detach)
2	Moderate (hard to detach)
3	Severe (need synchiolysis)

Table. 2C. Grading score for crustations

Score	Criteria
0	No
1	Mild
2	Moderate
3	Sever

Table.2D. Grading score for infection&discharge

Score	Criteria
0	No
1	Mild (scanty mucopurulent discharge)
2	Moderate (gross mucopurulent discharge)
3	Severe (profuse mucopurulent discharge)

Table. 2E.Grading score for Mucosal oedema

Score	criteria
0	No
1	Mild (no obvious cavity reduction, spacious maxillary sinus)
2	Moderate (obvious reduction with narrowing sinus orifice)
3	Middle turbinate exposed to lateral wall of nasal cavity

Statistical analysis:

Data management and statistical analysis were done using SPSS vs.25. (IBM, Armonk, New York, United states). Numerical data was summarized as medians and ranges. Comparisons between both groups were done using Wilcoxon test for numerical data. Categorical data was compared using Chi-square test or Fisher's exact test if appropriate. All P values were two sided. P values less than 0.05 were considered significant.

Results:

A total of 40 patients were included in this study, they were 25 males (62.5%) and 15 females (37.5%); age ranges from 15 to 45 with a mean age of 30 years (**Table 3A**).

Table. 3A. General characteristics of study population (n=40).

Age		Mean±SD	30±7
Sex	Male	N%	25(62.5%)
	Female	N%	15(37.5%)

The presenting clinical symptoms in patients of our study are nasal obstruction presented in 20 patients (50.0%), nasal discharge presented in 15 patients (37.5%), headache presented in 15 patients (37.5%), hyposmia presented in 10 patients (25.0%), facial pain presented in 20 patients (50.0%) and postnasal discharge presented in 15 patients (37.5%) (**Table 3B**).

Table. 3B. Presenting clinical symptoms of study population.

Clinical symptoms	N	%
Nasal obstruction	20	50.0%
Nasal discharge	15	37.5%
Headache	15	37.5%
Hyposmia	10	25.0%
Facial pain	20	50.0%
Postnasal discharge	15	37.5%

The most frequent endoscopic finding was discharge with no polypi (40.0%) while the least frequent was HIT (5.0%). The most frequent operation done was FESS (75.0%). (**Table 3C**).

Table. 3C. Endoscopic finding &operations done of study population**.**

Endoscopic	N%
discharge in middle meatus with no polypi	16 (40.0%)
DS	3 (7.5%)
DS&HIT	5 (12.5%)
HIT	2 (5.0%)
Polypi	14 (35.0%)
Operations	
FESS	30 (75.0%)
Septoplasty	3 (7.5%)
Septoturbinoplasty	5 (12.5%)
Turbinectomy	2 (5.0%)

The absorbable packing material (Group I) was randomly assigned to 25 right nasal cavities (62.5%) and 15 left nasal cavities (37.5%). The non-absorbable (Goup II) was assigned accordingly in 15 left and 25 right cavities (**Fig 4**).

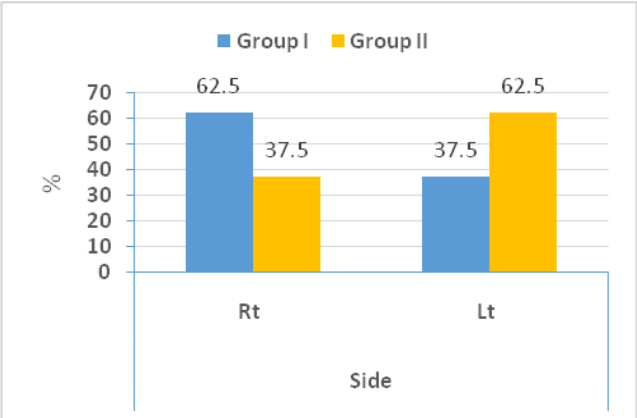

Fig.4 . Side distribution

Subjective assessment:

All 40 patients answered the VAS about pain before pack removal, during removal and follow-up visits.

Before removal of pack: On the absorbable side (group I),

Pain score measured 1hour postoperative, ranged from 0 to 7 (median 4), 3hours ranged from 0 to 7 (median 7), 12 hours ranged from 0 to 7 (median 3), 24 hours ranged from 0 to 4 (median 2) and 48 hours ranged from 0 to 4 (median 0). On Merocel side (groupII), pain score measured 1 hour postoperative ranged from 5 to 9 (median 7), 3hours ranged from 5 to 9 (median 7), 12 hours ranged from 4 to 7 (median 6), 24 hours ranged from 0 to 7 (median 5) and 48 hours ranged 0 to 7 (median 5). There was a highly significant differencewith **p value <0.001** (**Table 4A, Fig 5A**).

Table. 4A. Pain (during packing) score between two groups

		Group I (n = 40)	Group II (n = 40)	P value
1 hour	Median (IQR)	4 (0 - 7)	7 (5 - 9)	<0.001
3 hours	Median (IQR)	4 (0 - 7)	7 (5 - 9)	<0.001
12 hours	Median (IQR)	3 (0 - 7)	6 (4 - 7)	<0.001
24 hours	Median (IQR)	2 (0 - 4)	5 (0 - 7)	<0.001
48 hours	Median (IQR)	0 (0 - 4)	5 (0 - 7)	<0.001

IQR=Inter-quartile range

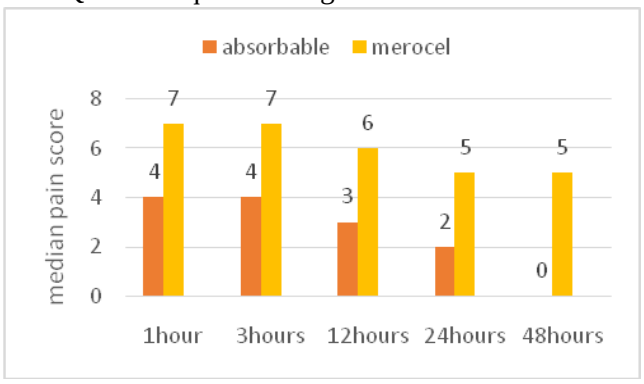

Fig.5A. Median pain scores (before pack remval) in both groups

During removal of pack, the absorbable packed sides had lower pain scores (ranged from 0 to 4) than Merocel packed ones (ranged from 6 to 10), median 0 vs 7 with **p value <0.001**.

During follow-up visits: on the absorbable side, there were lower pain scores ranged from 0 to 5 (median 1) after 1 week, ranged from 0 to 5 (median 1) after 2 weeks, ranged from 0 to 3 (median 0) after 4weeks, ranged from 0 to 1 (median 0) after 6 weeks and was 0 in all patients after 12 weeks. However, on the Merocel side, ranged from 0 to 8 (median 7) after 1week, ranged from 0 to 7 (median 5) after 2weeks, ranged from 0 to 5 (median 3) after 4 weeks,ranged from 0 to 5 (median 1) and ranged from 0 to 5 (median 0) after 12 weeks.There was a highly significant difference with **p value <0.001** (**Table 4B**…**Fig 5B**).

Table.4B. Pain score between two groups

		Group I (n = 40)	Group II (n = 40)	P value
3rd day	Median (IQR)	0 (0 - 4)	7 (6 - 10)	<0.001
1 week	Median (IQR)	1 (0 - 5)	7 (0 - 8)	<0.001
2 weeks	Median (IQR)	1 (0 - 5)	5 (0 - 7)	<0.001
4 weeks	Median (IQR)	0 (0 - 3)	3 (0 - 5)	<0.001
6 weeks	Median (IQR)	0 (0 - 1)	1 (0 - 5)	0.001
12 weeks	Median (IQR)	0 (0 - 0)	0 (0 - 5)	<0.001

IQR= Inter-quartile range

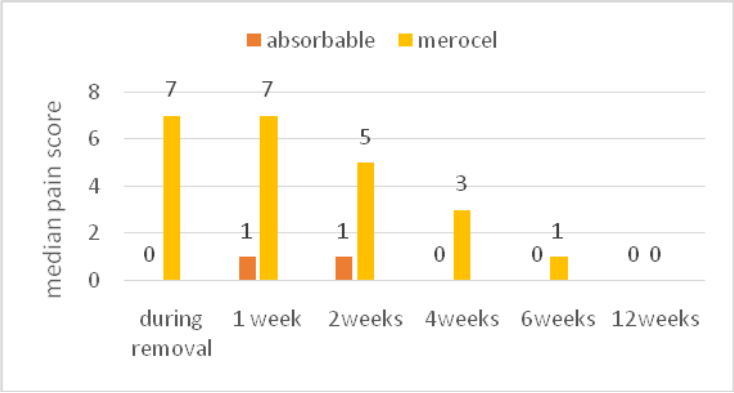

Fig. 5B. Median pain scores on both sides during &after pack removal.

Regarding nasal obstruction, Patients' discomfort due to sense of nasal obstruction was much more on the Merocel side. The difference was statistically higher significant, **p value < 0.05**. However, no significant difference in nasal obstruction between two sides before pack removal, at 3rd day and after 2 weeks. **P value >0.05** (**Table 5A**).

However, there was a highly significant difference in nasal obstruction scores between two sides, ranged from 0 to 1 on the absorbable side and from 0 to 3 on the Merocel side. No a statistically significant difference in scores after 2weeks and 12weeks postoperatively. (Fig 6).

Table. 5A. Nasal obstruction distribution in both groups.

		Absorbable n =40	Merocel n =40	p value
Before removal	Positive n (%)	35 (87.5)	40 (100.0)	0.055
3rd day	Positive n (%)	30 (75.0)	35 (87.5)	0.152
2 weeks	Positive n (%)	15 (37.5)	20 (50.0)	0.26

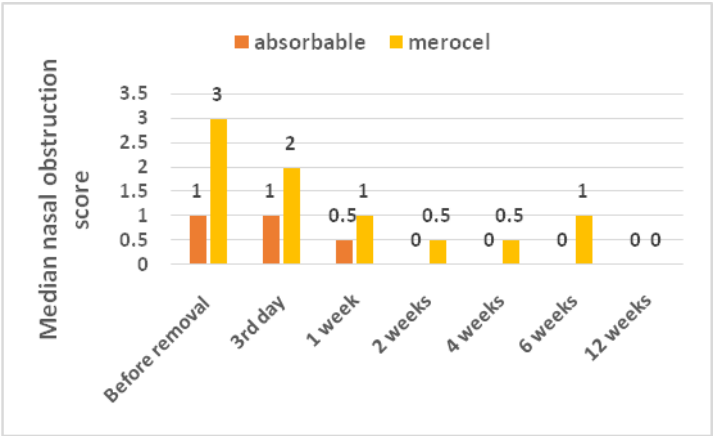

Fig.6. Median nasal obstruction scores in both groups.

At 1 week, nasal discharge was significantly higher in Merocel group (37.5%) compared to absorbable group (0%), **p value <0.001**. At 2 weeks, discharge was much more on Merocel side (50.0%) than on the absorbable side (20.0%) with a highly significant difference, **p value 0.005**. No significant difference after 4weeks, 6weeks and 12 weeks, **p value >0.05** (**Table 5B**).

Table.5B. Nasal discharge distribution between two groups

		Absorbable (n = 40)	Merocel (n = 40)	P value
1 week	Positive n (%)	0 (0.0)	15 (37.5)	<0.001
2 weeks	Positive n (%)	8 (20.0)	20 (50.0)	0.005
4 weeks	Positive n (%)	10 (25.0)	14 (35.0)	0.329
6 weeks	Positive n (%)	5 (12.5)	9 (22.5)	0.239
12 weeks	Positive n (%)	2 (5.0)	6 (15.0)	0.263

Objective assessment:

Bleeding score was higher on the absorbable side, ranged from 0 to 3 (median 1), than on the Merocel side, ranged from 0 to 2 (median 0). This was a significantly higher difference (**p value = 0.002).** At 3rd day, no significant difference between both groups (**p value = 0.399).** During removal of packing, bleeding ranged from 0 to 1 (median 0) on absorbable side, but it ranged from 0 to 2 (median 1) on Merocel side. This was a highly significant difference (**p value<0.001**) **(Table 6A…Fig 7A).**

Table. 6A. Bleeding score between both groups

Bleeding		Absorbable (n=40)	Merocel (n=40)	P value
Early postoperative	Median (IQR)	1 (0-3)	0 (0-2)	0.002
3rd day	Median (IQR)	0 (0-1)	0 (0-1)	0.399
During removal	Median (IQR)	0 (0-1)	1 (0-2)	<0.001
1 week	Median (IQR)	0 (0-0)	0 (0-0)	1.0
2 weeks	Median (IQR)	0 (0-0)	0 (0-0)	1.0

IQR=inter-quartile range

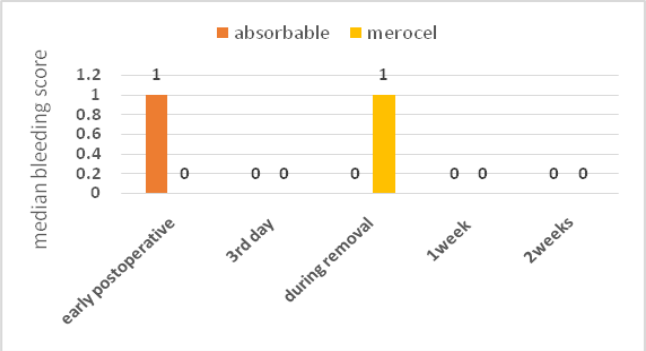

Fig. 7A. Median bleeding scores in both groups.

Regarding comparison between 3 materials used:

Early postoperative, 5.0% of patients packed with Gelfoam showed grade 1, 35.0% showed grade 2 and 50.0% showed grade 3. On the Sinufoam side (n=20), 15.0% showed grade 1, 10.0% showed grade 2 and no patients showed grade3. This was a statistically significant difference between Gelfoam & Sinufoam.

On the Merocele side (n=40), 30.0% showed grade 1, 5.0% showed grade 2 and no patients showed grade 3. This was a statistically significant difference between Merocel and Gelfoam. Regarding 3 materials, there was a highly significant difference, **All p<0.001**.

At 3rd day, Incidence of bleeding decreased to be 20.0% on Gelfoam sides, 5.0% on Merocel sides and no cases reported on Sinufoam sides.

During removal, 20.0% of Gelfoam packed sides showed grade 1. No cases reported with Sinufoam. However, 42.5% of Merocel packed side showed grade 1 and 40.0% showed grade 2, so Merocel had a higher bleeding frequency compared to Gelfoam and Sinufoam. Regarding 3 materials, there was a highly significant difference, **All p<0.001(Fig 7 B).**

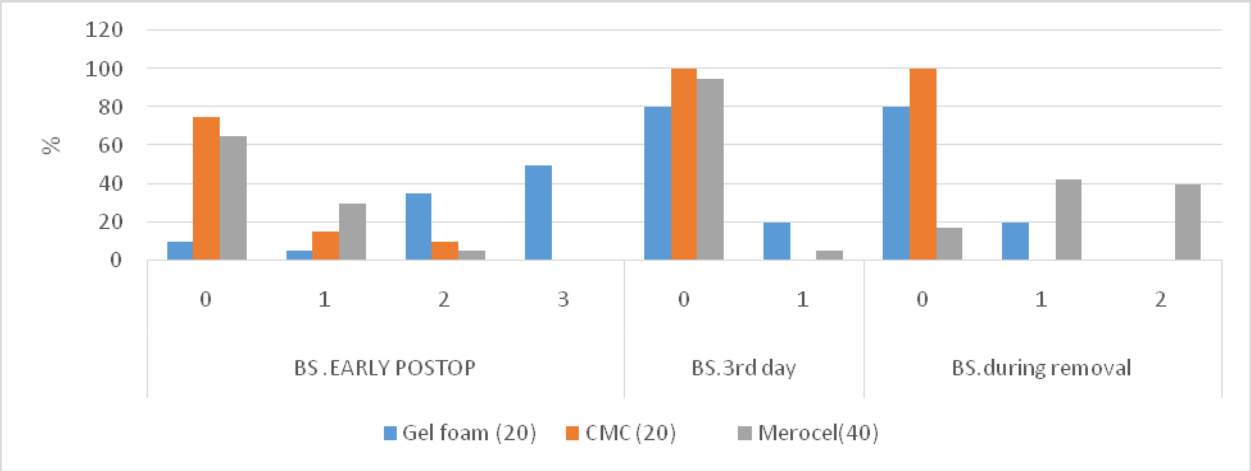

Fig. 7B. Bleeding score (BS) distribution between materials used.

Crustation score was significantly higher in the Merocel group compared to the absorbable group at 1week, 2weeks, 4weeks, 6weeks and 12weeks (**Table 7….Fig 8A**).

Table. 7. Crustation score between two groups

crustation		Absorbable (n=40)	Merocel (n=40)	P value
1 week	Median (IQR)	0 (0-1)	1 (0-2)	<0.001
2 weeks	Median (IQR)	1 (0-2)	1 (0-3)	0.026
4 weeks	Median (IQR)	0 (0-2)	1 (0-3)	0.006
6 weeks	Median (IQR)	0 (0-2)	1 (0-3)	0.001
12 weeks	Median (IQR)	0 (0-1)	0 (0-2)	0.002

IQR= Inter-quartile range

Fig. 8A. crustation score in both groups.

Regarding comparison between 3 materials used:

At 1 week, 35% of Gelfoam group showed mild crustations, 40% of Sinufoam group showed mild crustations. The Merocel group had higher crustations compared to Sinufoam and Gelfoam as 52% showed mild crustations and 22% showed severe crustations. This was a statistically high significant difference, **All p=0.002** .

At 2 weeks, crustations were higher in Gelfoam (60%) compared to Sinufoam (30%). The Merocel group showed higher crustations (70%) compared to Gelfoam & Sinufoam.

At4 weeks, no difference between the groups, **All p=0.15**.

At 6 weeks, the Merocel showed higher crustations (50%) compared to Gelfoam (35%) and Sinufoam (5%).This was a statistically significant difference, **All p=0.011**.

At 12 weeks, 10% showed mild crustations in Gelfoam group. The Merocel group showed higher crustaions 32.5% compared to Sinufoam 0%.There was a statistically significant difference. **All p=0.017** (**Fig 8B**).

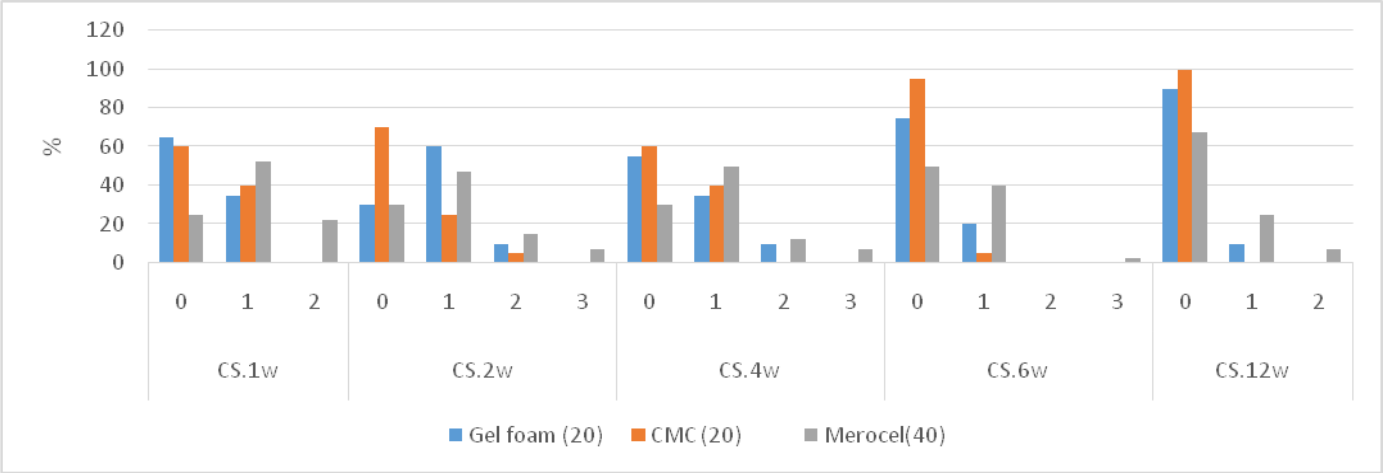

Fig. 8B. Crustations score (CS) distribution between materials used.

Adhesions score was significantly higher in the Merocel group, ranged from 0 to 2 at 2 weeks, ranged from 0 to 3 at 4,6 and12 weeks after surgery, compared to the absorbable group, ranged from 0 to 1 at 2 and 12 weeks, ranged from 0 to 2 at 4 and 6 weeks. **P value was 0.027, <0.001, <0.001, 0.012 respectively**. No significant difference at 1&12weeks **(Table 8, Fig 9A**).

Table. 8. Adhesions score between two groups

Adhesios		Absorbable (n=40)	Merocel (n=40)	P value
1 week	Median (IQR)	0 (0-1)	0 (0-1)	0.366
2 weeks	Median (IQR)	0 (0-1)	0 (0-2)	0.027
4 weeks	Median (IQR)	0 (0-2)	1 (0-3)	<0.001
6 weeks	Median (IQR)	0 (0-2)	1 (0-3)	<0.001
12 weeks	Median (IQR)	0 (0-1)	0 (0-3)	0.012

IQR= Inter-quartile range.

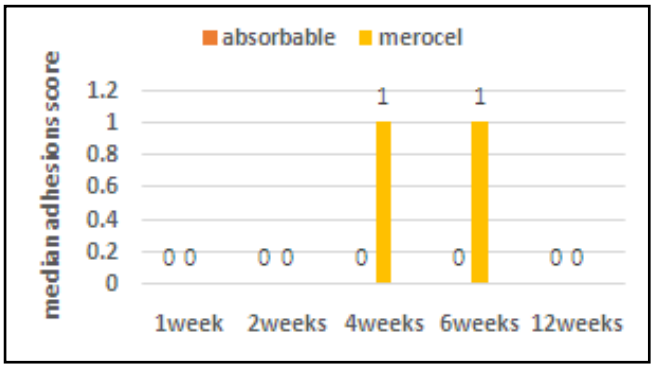

Fig. 9A. Median adhesion scores in both groups.

Regarding comparison between 3 materials used:

At 1 week, 25% developed mild adhesions in Gelfoam group, 20% developed mild adhesions in Merocel group .There was a statistically significant difference between Merocele & Sinufoam and between Sinufoam & Gelfoam.

At 2 weeks, 25% developed mild to moderate adhesions in Gelfoam group, 32.5% developed mild to moderate adhesions in the Merocel group. There was a statistically significant difference between Merocele & Sinufoam and between Sinufoam & Gelfoam.

At 4 weeks, 40% developed mild to moderate adhesion in Gelfoam group, 10% developed mild to moderate adhesions. The Merocel group has significantly higher adhesions as 80% developed mild to severe adhesions.

At 6 weeks, The Gelfoam group had significantly higher adhesions compared to the Sinufoam group. The Merocel group developed adhesions with a high frequency (62.5%) compared to the Sinufoam. This was a highly significant difference, **All p = 0.001**. No significant difference at12weeks (**Fig 9B**).

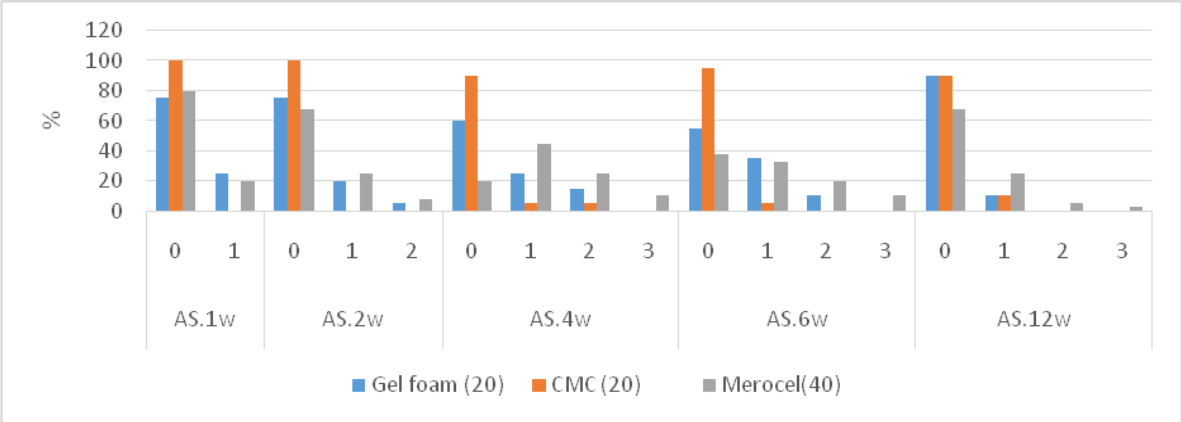

Fig. 9B. Adhesions score (AS) distribution between materials used.

Mucosal oedema:

Median mucosal oedema score was significantly higher in the Merocel group compared to the absorbable group at 1,2,4 weeks, **p value <0.001**. No significant difference in mucosal oedema score at 6 &12 weeks, **p value>0.05.** (**Table 9, Fig 10A**)

Table.9.Mucosal oedema score between two groups

Mucosal oedema		Absorbable (n=40)	Merocel (n=40)	P value
1 week	**Median (IQR)**	1 (0-1)	1 (0-3)	<0.001
2 weeks	**Median (IQR)**	0 (0-2)	1 (0-3)	<0.001
4 weeks	**Median (IQR)**	0 (0-1)	1 (0-2)	<0.001
6 weeks	**Median (IQR)**	0 (0-1)	0 (0-3)	0.139
12 weeks	**Median (IQR)**	0 (0-1)	0 (0-1)	0.238

IQR= Inter-quartile range

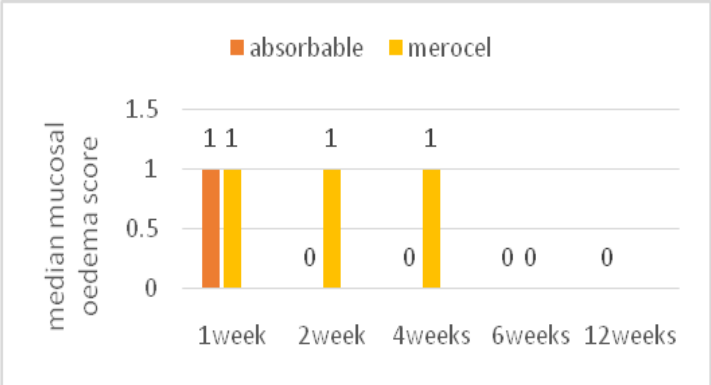

Fig. 10A. Median mucosal oedems score in both groups.

Regarding comparison between 3 materials used:

At 1,2weeks, Merocel group had significantly higher mucosal oedema compared to Gelfoam & Sinufoam, **p value was <0.001** at 1week, was **0.001** at 2 weeks.

At 4weeks, There was a statistically significant difference comparing Merocel with Gelfoam & Sinufoam, **p value was 0.022**.

At 6weeks, the Merocel group had higher oedema (40% of cases) compared to Sinufoam(20% of cases) with significant difference. The Sinufoam was compared to Gelfoam with a significant difference inbetween. No statistical difference in comparing all materials, **all p <0.05**.

At 12weeks, no significant difference between materials used, **p =0.34** (**Fig 10B**)

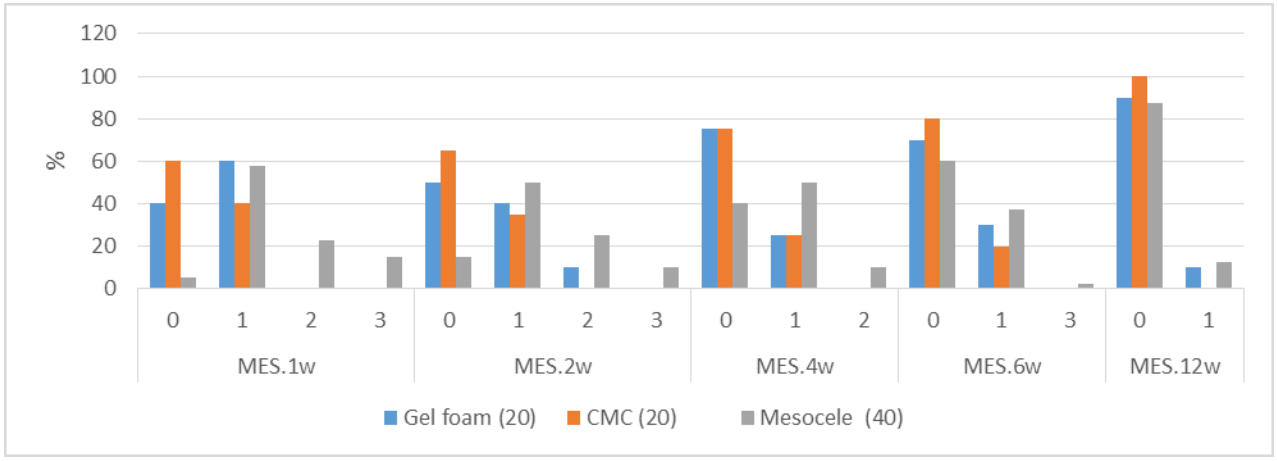

Fig. 10B. Mucosal oedema score (MES) distribution between materials used.

Infection & discharge :

The only significant difference was at 1 week, **p value <0.001** and 2 weeks, **p value =0.021. At 1 week,** Infection and discharge score was significantly higher in the Merocel than absorbable group. It ranged from 0 to 2 on Merocel packed sides and from 0 to 0 on absorbable ones. (**Table 10**).

Table.10. Infection &discharge score between two groups

Infection &discharge		Absorbable (n=40)	Merocel (n=40)	P value
1 week	Median (IQR)	0 (0-0)	0 (0-2)	<0.001
2 weeks	Median (IQR)	0 (0-3)	0.5 (0-2)	0.021
4 weeks	Median (IQR)	0 (0-2)	0 (0-2)	0.377
6 weeks	Median (IQR)	0 (0-2)	0 (0-2)	0.348
12 weeks	Median (IQR)	0 (0-2)	0 (0-2)	0.149

IQR= Inter-quartile range

At 1 week, infection & discharge were significantly higher in the Merocel group (37.5%) compared to the absorbable group (0.0%). **P value was <0.001**

At 2 weeks, infection & discharge were significantly higher in Merocel group (50.0%) compared to the absorbable group (20.0%). **P value was 0.005**.

There was no significant differences between both groups at 4, 6 and 12 weeks (**Fig 11**).

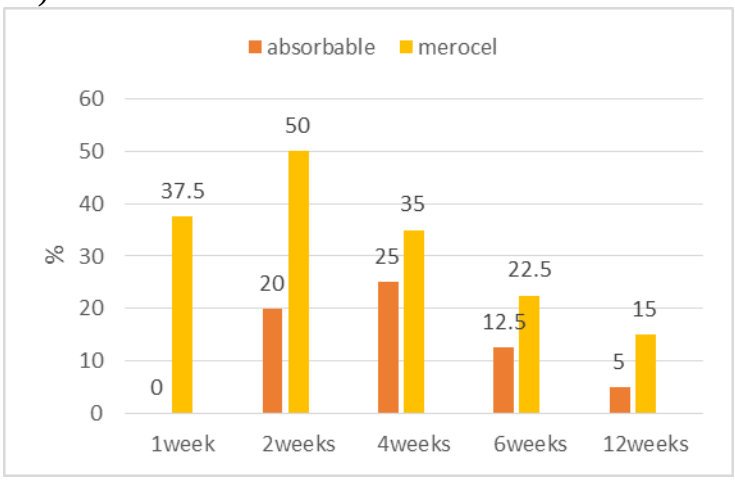

Fig. 11A. Infection and discharge distribution in both groups

Regarding comparison between 3 materials used:

At 1week, Merocel group showed mild infection in 32.5% and moderate in 5.0%, compared to Sinufoam (0.0%) and Gelfoam (0.0**%), P value <0.001**.

At 2weeks, Merocel, Sinufoam and Gelfoam showed mild infection in 40.0%, 16.0%, 3.0% respectively. Also, showed moderate infection in 10.0%, 4.0%, 1.0% respectively. However, Gelfoam was the only side which showed severe infection. The difference was significantly higher in Merocel

group compared to Gelfoam group and Sinufoam grop. **All P value 0.001.**

At 6weeks, Sinufoam group did not record any infection. infection and discharge were statistically significant in Gelfoam group and Merocel group compared to Sinufoam group ,**All p value 0.007**. No significant difference in materials at 4 or 12 weeks, **All p >0.05 (Fig 11B).**

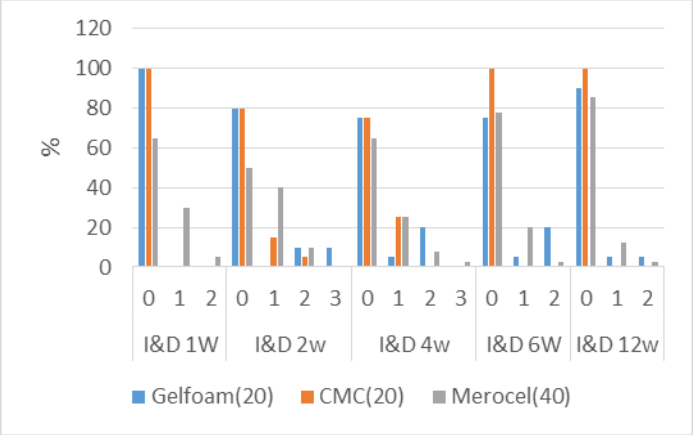

Fig. 11B. Infection & Discharge(I&D) score distribution between materials

Discussion:

There is no worldwide estimation framework for outcomes related with nasal packings after surgeries so the identification of a predominant nasal packing material is troublesome, although certain materials appear to be more viable than others in accomplishing incredible postoperative results.[9]

Nasal packing has been used to control bleeding after surgery and help mucosal healing. Unfortunately, several drawbacks appeared like infection, breathing troubles and discomfort.[10]

Traditional non-absorbable packing gives haemostasis through pressure and has been well known because of its availability and low cost. However, its removal after surgery is very painful and considered the worst procedure after surgery.[11]They are as yet effective in accomplishing certain results however newer absorbable substances might be similarly as successful and keep away from the drawbacks related with nasal packing removal. [12]

Emerging absorbable packing materials have put authors in a great debate about which type of nasal packing, wheather absorbable or not, has abetter effect on subjective and objective outcomes. [13]

Different materials used in different studies do not allow for selection of certain materials. Also some prefer not using any packs at all. Absorbable packings have been developed in recent years.

These absorbable materials can be one of 3 categories, dependent on the chemical composition: **extracellular matrix - based compounds** (gelatin film, gelatin foam, flowable gelatin - thrombin admixture, and hyaluronic acid), **coagulation cascade precipitants** (fibrin sealant), and **natural / synthetic biopolymers** (carboxymethyl-cellulose, extracellular matrix, microporous polysaccharide hemispheres, polyethylene glycol, chitosan gel, and polyurethane foam.[14].

There are no known standards for which type of packs to be used, when indicated, and the optimum duration for placement. However, packs should apply pressure, fill spaces and effectively help hemostatic and reparative process.[7]The most important consideration after nasal surgeries are patient satisfaction, minimize bleeding and discomfort associated with packing removal and also proper healing of mucosa.

In our study, patients had lower pain score on the absorbable side than on the Merocel side postoperatively, during pack removal and early follow-up visits.

The estimation of pain presents a few issues, yet visual analogue scales can be utilized to measure pain with high affectability and reproducibility.[15]The absorbable material begins to degrade in the 1st 24h after application and with proper nasal douches using saline, it terminates in 10 days after surgery, therefore does not cause much discomfort and bleeding. Merocel packing causes more damage to nasal mucosa with formation of blood clots around it, therefore causes much discomfort.

Many studies reported that discomfort occurred with Merocel, ***Berlucchi et al.***[16]who compared it with Merogel (Hyalurnic acid), ***Lu and Zhang***[17]and ***Wang et al.***[10]who compared it with Nasopore and also ***Leunig et al.***[18]who detected that there was no difference between CMC packing and no packing at all. Nasopore was also compared with Merocel after FESS by ***Shoman et al.***[19]and after septoplasty by ***Kim et al.***[17]**,** ***Yilmaz et al.***[21]and ***Romano et al.***[22]

Subjective parameters such as nasal blockage and discharge were also assessed and were generally lower for the absorbable side.

Nasal obstruction showed no a statistically significant difference between both sides at 3rd day, 2weeks postoperative. This was caused by the start of resorption of the packing which completed at 7 to 10 days. Nasal obstruction was much more on the Merocel side because of much mucosal oedema and secretions. Nasal discharge was much more on the Merocel side with a statistically highly significant difference at 1st two weeks after surgery then showed no difference between absorbable and non-absorbable. The same observations have been reported by ***Al-Madani et al.***[23], ***Berlucchi etal.***[16]**,** ***Wang et al.***[10]**,** ***Kim et al.***[17]**and** ***Yilmaz et al.***[21]

This study demonstrated that absorbable packing does not significantly reduce postoperative bleeding. Bleeding was significantly higher on the absorbable side early postoperative, then no significant difference between both sides at 3rd day. On Gelfoam side, bleeding was significantly higher compared to Sinufoam and Merocel, 90% vs 25% and 35% respectively The Merocel group showed higher bleeding incidence compared to Sinufoam and Gelfoam during removal, 82.5% vs 0% and 20% respectively. As there was no need to remove the absorbable packing, no mucosal injury occurred so no significant bleeding recorded.

This is consistent with the results of ***Lu and Zhang.***[16]who did not report any difference between Merocel and absorbable pack (AquacelAg). Also, ***Saedi et al.***[24]showed that there was no significant difference between Merocel and no packing. ***Frienkiel et al.***[25]found no difference for hemostasis between Hyaluronic acid and no packing**.** Another study by ***Shoman et al.***[19]compared Nasopore with Merocel placed in a vinyl glove finger and found no significant difference**.** ***Cho et al.***[26]compared Merocel with absorbable Cutanplast and reported more significant bleeding on removal. ***Karkos et al.***[27]evaluated CMC Sinu-Knit (small dry pack, mixed with saline before use) and found oozing early postoperative but no interventions were needed.

On the other side, the better effect of biodegradable materials on hemostasis was reported. ***Stankiewicz***[28]stated that Flosel was better compared to Merocel. ***Gall RM et al.***[29]found Flosel (gelatin-thrombin admixture) to be a better hemostatic pack compared to no packing. ***Beyea JA and Rotenberg BW.***[30] reported the same result with Flosel when was compared capabilities to a plant-based polysaccharide (**HemoStase; Cryolife Inc, Kennesaw, Georgia).** ***Al-Madani A et al.***[23] reported the same hemostatic effect with different absorbable materials used (gelfoam, surgiflo, sinufoam). Also, ***Kastl et al.***[8]showed that oxidized cellulose powder is more effective than PVA in controlling bleeding. ***Kim et al.***[11]showed that 18.8% of those packed with absorbable synthetic **polyurethane foam** following FESS had bleeding compared with 81% of the Merocel group. Additionally, ***A.Romano et al.***[22] showed the same result with the Nasopore.

Regarding crustations, the absorbable side recorded significantly lower scores than the Merocel. At 4th week, no significant difference recorded. This can perhaps be explained by the fact that there is no need for removal of the absorbable packs, so there is less crusting

&secretions. Later crusts disappear. This agrees with ***A.Romano et al***.[22]***and Shoman N et al.***[19]

In the current study, no significant difference in 1st week and 12 weeks regarding adhesion formations between absorbable and non-absorbable packed sides. The difference was at 2, 4 and 6 weeks. Merocel had higher adhesion scores than the absorbable ones. This perhaps was due to complete resorption of materials with no remnants and respect of regular intense nasal rinsing during recovery period.

This agrees with ***A. Romano et al.***[22]who found reduction of adhesions in Nasopore group**.** ***Hu et al.***[22] found that there was a decrease in the rate of synechia among patients who got absorbable packings compared with those who received no packing. ***Berlucchi et al.***[22]performed a prospective randomized controlled study looking at the impacts of Merogel and standard non absorbable packing at 2, 4, and 12 weeks after ESS in 66 patients. They found lower rates of adhesions formation in the Merogel group at both 4 and 12 weeks after the operation.

In contrast, ***Chandra et al.***[32] performed a randomized controlled trial contrasting the impacts of Floseal and thrombin-soaked gelatin foam, and they found that Floseal significantly increased adhesion. ***Baumann and Caversaccio***[33] in a prospective non-randomized study showed that there was a little difference in the rate of synechia between Floseal and Merocel. ***Wang et al.***[10] showed that the absorbable nasal packing was not associated with a significantly lower risk of synechia after FESS compared with traditional nasal packing. ***Miller et al***[34] in a randomized, controlled study stated that the rate of synechia formation in both groups at about 2 months after the operation was nearly the equivalent. ***Al-Madani et al.***[23] is consistent with.

Regarding CMC, ***Szczygielski K et al.***[6] compared it with no packing. CMC foam performed similarly to PVA sheathed in a latex glove finger for hemostasis and wound healing. ***Kastl et al.***[8] performeda prospective study comparing CMC-gel or Sinu knit with no packs after FESS. There were no differences in patient comfort (nasal obstruction, headache, pressure, sleep disturbance), wound healing (crustations, adhesions, granulations, wound closure)and postoperative hemorrhage. Also, CMC with dexamethasone was evaluated by ***Rudmik et al.***[35] and found it equal unmedicated CMC for wound healing.

The degree of mucosal oedema reflects the degree of operative trauma to mucosa and underlying infection. This can cause temporary obstruction with consequent persistence of postoperative symptoms, so steroids are used to decrease oedema.

In this study, oedema score was significantly lower on the absorbable side than the Merocel side. Incidence of oedema was significantly higher on the Merocel-packed sides compared to Gelfoam and Sinufoam packed sides till the 6th week. Then no difference was recorded. This was against the results reported by ***Lu and Zhang.***[17]**,** ***Wee et al.***[37]***and Al-Madani et al.***[23]

Another important issue to consider is the significant reduction in infection and discharge at 1st week on the absorbable side. This is the same observation of ***A. Romano et al.***[22] ***Wormald et al***.[36] reported that Merogel have no significant benefit in terms of synechia, edema and infection

In this study, we compare absorbable with traditional non-absorbable packing to clarify the effect on wound healing represented in crustations, adhesions, mucosal oedema and secretions. Long follow-up was planned for better longterm results.

Conclusion:

Absorbable nasal packings can be a good alternative to traditional packings as patients' comfort is higher when using Sinufoam or Gelfoam compared to Merocel. This comfort is associated with minimal pain, nasal blockage, and discharge. Using these packs help to avoid bleeding during removal of traditional packs. However, They also associated with low ability of hemostasis early postoperative. Sinufoam and Gelfoam seem to decrease adhesions, crustations, mucosal oedem and infection especially Sinufoam. This help for better aeration, repair and regain of nasal physiology**.** Gelfoam was associated with very high incidence of bleeding.

Recommendation:

We recommend CMC Foam to be a safe, accepted and well tolerated alternative to the traditional packings. More studies should be conducted to evaluate hemostatic properties. This is needed to be available with lower cost. Gelfoam needs more studies.

Conflicts of interest

None.

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