Clinical evaluation of the nose: a cheap and effective tool for the nasal fracture diagnosis ©

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ABSTRACT

Study objective: An accurate diagnosis of nasal fractures depends on a thorough history and physical examination. The purpose of this investigation was to find an easy way to establish the diagnosis of nasal fracture based on just clinical criteria.

Methods: It was historical cohort study with 220 clinical charts of patients suspected of nasal fracture, enrolled from 2003 to 2004. For the statistical analysis were considered when comparing with the gold standard: one clinical criterion(7), all the possible combinations of two clinical criteria(21) and 3 clinical criteria(35).These were the clinical criteria considered for the analysis: epistaxis, periorbital and/or perinasal ecchymosis, nasal wound or laceration, airway obstruction, nasal inflammation, lateral deviation and irregular nasal dorsum. Validity values were calculated with a 95% confidence interval.

Results: The overall sensitivity rate and the negative predictive value (NPV) for the detection of nasal fracture were very low (below 35%). On the contrary, specificity and positive predictive value were very high (above 90%) and increase progressively: 92% and 94% when at least one clinical criterion was present; 98% and 96% when at least 2 clinical criteria were present at the same time; 100% and 100% when at least 3 clinical criteria were present at the same time.

Conclusion: The presentation of the clinical criteria proposed, is a reliable and easy method for the diagnosis of nasal fracture, nevertheless, when these clinical criteria are

absent, the possibility of the nasal fracture can't be rule out in spite of the fact this possibility is quite remote (2.73%).

INTRODUCTION

Background

The nose can be considered as the single most prominent aesthetic feature of the face and the fracture of its nasal bones is the most common bone injury of the adult face and the third of the overall body. It is estimated that on the facial region, nose bones fractures are presented in almost 40% of the cases.[1] In fact, according to the National Institute for Health Statistics, each year about 50000 people suffer from nasal bones fractures in USA.[2] Actually, accidents caused by motor vehicles and interpersonal violence are considered as the main causes of nasal bones fractures, and alcohol consumption is often as a present factor.[3]

Frequently, nasal fracture is considered as a minor problem, nevertheless it might be an error since it could result in important functional or cosmetic defects,[4] that are associated to many factors as the timing, traumatic edema, preexisting nasal deformity and occult septal injury.[5]

An accurate diagnosis of nasal fractures depends on a thorough history and physical examination.[6] Patients with nasal fractures usually present with some combination of epistaxis, ecchymosis, deformity, tenderness, edema, instability, and crepitation; however, these features may not be present or may be transient.[7]

The standard imaging procedure for suspected nasal fractures has been radiography (XR). However, its usefulness for clinical decision making is highly controversial. For detection of fractures of the nasal dorsum, XR has high sensitivity (88%) and specificity

(95%). Nevertheless, in lateral nasal wall fractures, specificity is higher (75%) than sensitivity (28%).[8] CT scans have greater sensitivity and specificity for nasal fracture, but their cost, radiation exposure, and lack of impact on management do not justify their use in diagnosing isolated nasal fractures but when managing the patient with extensive maxillofacial trauma.[9]

Goal of this investigation

Based on the fact that nasal fractures can be accurately diagnosed with a thorough history and physical examination. Nevertheless, this statement is applicable for the specialist or the physician with high experience in nasal fractures. For that reason, to find an easy way to establish the diagnosis of nasal fracture for the general physician or the emergency physician, based on just the clinical history would be very useful. The value of the several clinical diagnostic criteria for the nasal fracture has not been formally compared with one another and when the clinical criteria are grouped. In order to determine how is possible to achieve an accurate diagnosis, the purpose of this investigation was to retrospectively review the frequency and accuracy of the clinical criteria of fracture, single and grouped, in 220 patients evaluated.

MATERIALS AND METHODS

Study Design

It was a retrospective cohort study, also called a historical cohort study (retrospective, longitudinal, observational analytical study) with clinical histories of patients suspected of nasal fracture.

Setting

The information was compiled from clinical histories gathered from the database of Maxillofacial Surgery Department at a hospital for labour accidents, from January 2003 to December 2004. I was looking for patients who fit the inclusion criteria.

Selection of participants

The chart review was performed by a trained plastic surgeon form the Maxillofacial Surgery Department with long standing experience in chart reviews.

220 patients with nasal trauma from January 2003 to December 2004 met the inclusion criteria and were selected for this study. The inclusion criteria were as follows: diagnosis suspect of nasal fracture and a detailed clinical history. The clinical history should include if the following clinical criteria (signs and symptoms) were or not present at the time of the consultation: epistaxis (EPI), periorbital and/or perinasal ecchymosis (ECH), nasal wound or laceration (NW), airway obstruction (AO), nasal inflammation (INF), lateral deviation (LD), irregular nasal dorsum (IND) and acute septal injury (ASI).

Methods of measurement

Gold standard or definitive clinical diagnosis of nasal fracture (nasal dorsum and nsasal wall) was determined taking into account all clinical data with x-rays (nasal bones and waters projections), intraoperative findings and CT scans.[8] Clinical data were compiled through an exhaustive medical history that included: the force, direction, and mechanism of injury; the presence of epistaxis or cerebrospinal fluid rhinorrhea at the moment of the consultation; any history of previous nasal fracture or surgery, nasal obstruction and epistaxis or external nasal deformity appreciated by the patient after the injury; signs from the examination of the external nose: periorbital and/or perinasal ecchymosis, nasal wound or laceration, airway obstruction, nasal inflammation, lateral deviation and irregular nasal dorsum; Inspection of the internal nose; Palpation of the nasal bones.

Data collection and processing

The following 7 clinical criteria, were recorded by one investigator, analyzed and individually compared with the definitive clinical diagnosis by another investigator: epistaxis (EPI), periorbital and/or perinasal ecchymosis (ECH), nasal wound or laceration (NW), airway obstruction (AO), nasal inflammation (INF), lateral deviation (LD), irregular nasal dorsum (IND) and acute septal injury. A positive acute septal injury was considered as: tear, laceration, hematoma or fracture. If a sign was not listed in the initial report, the finding was assumed to be negative. Findings were considered positive or negative for the analysis of the data.

Primary data analysis

Validity values were calculated with a 95% confidence interval (CI) following an exact binomial distribution. Ninety two comparisons were done with the gold standard. For the statistical analysis when comparing with the gold standard were considered: one clinical criterion (8), all the possible combinations of two clinical criteria (28 combinations without repetition=$C_{8,2}$) and 3 clinical criteria (56 combinations without repetition=$C_{8,3}$). Sensitivities and specificities were compared using the McNemar test for paired samples with two tails. Predictive values were compared using Fisher's exact test with two tails. The level of significance was corrected with the Bonferroni test in order to acknowledge the existence of three comparisons.

Decimals resulting from the analysis of the data for the prevalence, sensitivity, and predictives values were not considered and approximation by excess was done.

The association of gold standart results with clinical criteria was studied by a multivariable logistic regression model, and results were shown as odds ratios (OR) with the associated 95% confidence intervals (CI) and the logistic regression formula derived (y =

$c_0 + c_1x_1 + c_2x_2 + c_3x_3$....). All data were analyzed using the SPSS software package, version 17.0 (Chicago, IL).

RESULTS

Characteristics of study subjects

220 patients were enrolled and included in the analysis. In this cohort, 157 (71.4%) were men, 63 were women (28.6%) and the median age was 36±25 years. Baseline characteristics are shown in Table 1.

Main results

The prevalence, sensitivity, specificity, positive predictive values and negatives predictive values of the different clinical criteria are shown in Table 2. Seventy six per cent (167) of the patients had nasal fracture. The single clinical criterion with the highest sensitivity and NPV was epistaxis (69% and 50%). The overall sensitivity rate for the detection of nasal fracture when at least one clinical criterion was present was 34% and the negative predictive value (NPV) 32%. Nevertheless, the specificity and positive predictive value (PPV) were 92% and 94% respectively. The single clinical criterion with the highest specificity and PPV was acute septal injury (100% and 100%) followed by ecchymosis (98% and 98%), airway obstruction and lateral deviation (both had the same values: 96% and 96%).

The prevalence, sensitivity, specificity, positive predictive values and negatives predictive values for all the combinations of two clinical criteria and the overall combination of 3 clinical criteria are shown in Table 3. The overall sensitivity rate for the detection of nasal fracture when at least two clinical criteria were present at the same time was 11% and the

NPV 26%. Nevertheless, the specificity and PPV were 98% and 96% respectively. When at least 3 clinical criteria were present at the same time the sensitivity and NPV were very low (6% and 25%) but the specificity and PPV achieved both the 100%.

From the 8 variables included for the analysis, just 4 were found as indepedent variables (EPI, ECH, INF and ASI) and contributed to the loggistic regression formula calculated "*y=0.03+0.47EPI+0.27ECH+0.36INF+0.26ASI"* (table 4). From the 4 independent variables studied, ASI was the only one with the maximum OR value (infinite) and the minimum 95% confidence interval value (zero).

LIMITATIONS

This study had several limitations:

1. The sample of the study was small (220 patients).
2. The patients included in the investigation, consisted solely of patients who were clinically suspected of having nasal fractures, admitted to the Maxillofacial Department at a hospital that is only for labour accidents.
3. The strict inclusion criteria didn't consider many patients for the study.
4. Palpation of the nasal bones were not included for the analysis, in spite of its importance for nasal fracture diagnosis, because when the nose is inflamed, is difficult even for the specialist physician the assessment of the nasal bones crepitation.

DISCUSSION

First of all, it's going to be reminded the meaning of the senstivity, specifity, PPV and NPV that have been used to determine the performance of the clinical criteria for the nasal fracture diagnosis, since many clinicians are frequently unclear about the practical application of these terms and can confuse them. The sensitivity of a test is defined as

the proportion of people with disease who will have a positive result. The specificity of a test is the proportion of people without the disease who will have a negative result. The positive predictive value of a test is defined as the proportion of people with a positive test result who actually have the disease. The negative predictive value of a test is the proportion of people with a negative test result who do not have disease. Sensitivity and specificity are important measures of the diagnostic accuracy of a test but cannot be used to estimate the probability of disease in an individual patient. Positive and negative predictive values provide estimates of probability of disease but both parameters vary according to disease prevalence. While sensitivity and specificity are important measures of the diagnostic accuracy of a test, they are of no practical use when it comes to helping the clinician estimate the probability of disease in individual patients, for this purpose predictive values are the most appropriate.[10]

The statistical analysis confirms what has been suggested by others, since the clinical diagnosis is a very appropriate tool for the diagnosis of nasal fracture.[5,6] Although the presence of epistaxis after nasal trauma has been associated with a statistically significant increase in external nasal deformity,[11] how important is each clinical criterion or the combination of them has never been established, for that reason, this study could be instructive in the clinical setting of nasal fracture. The sensitivity and NPV for one clinical criterion, alone or combined were very low (under 35%). Nevertheless, for the sensitivity and PPV things are completely different. Thus, 8% of patients will not have nasal fracture in spite of the fact that at least 1 clinical criterion will be present, or 92% of the patients without nasal fractures will not have at least a clinical criterion (specificity of 92%). Ninety four per cent of the patients with at least one clinical criterion will have nasal fracture (PPV). When at least 2 clinical criteria are present at the same time: 2% of

patients will not have nasal fracture in spite of the fact that at least 2 clinical criteria will be present or 98% of the patients without nasal fractures will not have at least 2 clinical criteria at the same time (98% of specificity); and 96% of patients with at least two clinical criteria at the same time will have nasal fracture (PPV). When 3 clinical criteria are present at the same time: 100% of patients without nasal fractures will not have at least 3 clinical criteria at the same time (100% of specificity) and 100% of patients with at least 3 clinical criteria at the same time will have nasal fracture (100% of PPV).

As was mentioned, for helping the clinician estimate the probability of disease in individual patients predictive values are the most suitable,[10] there we should focus on them. Analysing the results, in the same way that the clinical criteria "epistaxis" after nasal trauma is associated with a statistically significant increase in external nasal deformity and therefore a probably fracture,[11] the high PPV exposed for these clinical criteria, indicates a high probability of real nasal fracture, in fact when at least only one clinical criterion is present this probability will be 94%, when at least 2 clinical criteria are present at the same time this probability will be 96% and finally, when at least 3 clinical criteria are present at the same time this probability will be 100%. On the contrary, as well as there are patients without epistaxis following nasal trauma with external nasal deformity, hence could have nasal fracture and still need to be referred to the fractured nose clinic[11], the low NPV of these results indicate that when our clinical criteria are absent, the clinicians can't rule out the nasal fracture. Nevertheless, if we analyse the data and the loggistic regression formula calculated "*y=0.03+0.47EPI+0.27ECH+0.36INF+0.26ASI"*, we can see that although it is possible, is very difficult to have a nasal fracture (y) without a clinical criteria associated. This

probability is given by the previous constant term (0.03). In fact from the 220 patients evaluated just 6 patients (2.73%) had nasal fracture without clinical criteria associated.

ASI (acute septal injury) was the single clinical criterion with the maximum possible value for the specificity (100%), PPV (100%) and OR (infinite). This means that if there is an ASI there always will be a nasal fracture associated. The only problem is that from all the clinical criteria considered for the analysis, this is the most difficult for the general physician or the emergency physician, because a bright light and a nasal speculum are necessary for an accurate nasal septum inspection.

It could be summarized that clinical criteria are useful for the diagnosis of nasal fractures only when they are present, since when they are absent it is not possible to rule out the possibility of a nasal fracture in spite of the fact this possibility is quite remote (2.73%).

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Table 1. Baseline characteristics of the population

Number of subjects studied	220
Age mean	36±25
Males	157 (71%)
Females	63 (29%)
Males/Females	2.49/1
History of actual illness	29 (13%)
Previous nasal trauma	28 (13%)
Traumatic mechanism	
Road Accident	78 (35%)
Blunt object	45 (20%)
Fall accident	37 (17%)
Aggression	20 (9%)
Not categorized	41 (19%)

Table 2. Frecuencies distribution and statistical measures of the performance of each clinical criterion

Clinical Criterion	Percentage (n)	Sensitibity	Specificity	PPV	NPV
Epistaxis (EPI)	54% (119)	69%	94%	97%	50%
Ecchymosis (ECH)	20% (44)	26%	98%	98%	30%
Nasal Wound (NW)	42% (92)	46%	70%	83%	29%
Airway obstrucction (AO)	15% (33)	19%	96%	94%	27%
Inflammation (INF)	45% (98)	56%	92%	96%	40%
Lateral deviation (LD)	15% (32)	18%	96%	94%	27%
Irregular nasal dorsum (IND)	24% (52)	29%	92%	92%	29%
Acute septal injury (ASI)	8% (17)	10%	100%	100%	26%
Mean	**28%**	**34%**	**92%**	**94%**	**32%**
Fracture	76% (167)				

Table 3. Frecuencies distribution and statistical measures of the performance of grouped clinical criteria

Clinical Criteria	Prevalence (n)	Sensitibity	Specificity	PPV	NPV
EPI+ECH	14% (31)	19%	100%	100%	28%
EPI+NW	23% (50)	30%	100%	100%	31%
EPI+AO	12% (26)	10%	100%	100%	27%
EPI+INF	16% (35)	21%	100%	100%	29%
EPI+LD	11% (24)	14%	98%	96%	27%
EPI+IND	17% (37)	22%	98%	97%	28%
EPI+ASI	7% (15)	9%	100%	100%	26%
INF+ECH	14% (31)	18%	98%	97%	28%
INF+NW	22% (48)	26%	92%	92%	28%
INF+AO	10% (22)	12%	96%	91%	26%
INF+LD	7% (16)	10%	100%	100%	26%
INF+IND	14% (31)	17%	96%	94%	27%
INF+ACI	5% (6)	6%	100%	100%	25%
NW+ECH	10% (21)	12%	98%	95%	26%
NW+AO	7% (15)	8%	96%	87%	25%
NW+ND	5% (11)	7%	100%	100%	25%
NW+IND	13% (29)	16%	96%	93%	27%
NW+ASI	4% (8)	5%	100%	100%	25%
IND+ECH	8% (17)	10%	98%	94%	26%
IND+AO	8% (18)	10%	96%	89%	25%
IND+LD	6% (14)	7%	96%	86%	25%
IND+ASI	3% (6)	4%	100%	100%	25%
ECH+AO	5% (10)	5%	98%	90%	25%
ECH+ND	3% (6)	4%	100%	100%	25%
ECH+ASI	2% (4)	2%	100%	100%	25%
AO+ND	5% (11)	7%	100%	100%	25%
AO+ASI	2% (5)	3%	100%	100%	25%
ND+ASI	2% (5)	3%	100%	100%	25%
Mean	**9%**	**11%**	**98%**	**96%**	**26%**
Mean for 3 CC	**4%**	**6%**	**100%**	**100%**	**25%**

Table 4. Logistic regression analysis

Variables	Odds Ratios	95% Confidence intervals
Epistaxis (EPI)	25.03	6.82-91.89*
Ecchymosis (ECH)	8.95	1.02 -79.16*
Nasal Wound (NW)	2.35	0.95-5.79
Airway obstrucction (AO)	1.00	0.12-8.66
Inflammation (INF)	5.97	1.80-19.85*
Lateral deviation (LD)	2.15	0.33-14.17
Irregular nasal dorsum (IND)	1.57	0.35-7.03
Acute septal injury (ASI)	∞	0.00*
Logistic regression formula: *y=0.03+0.47EPI+0.27ECH+0.36INF+0.26ASI*		

*These are the significant clinical criteria (1 value is not included in the 95% confidence interval) or independent variables. The 0 value for the confidence interval of the ASI means that if there is an ASI there always will be a nasal fracture associated.

Statistical draft

Table 1. Frecuencies distribution and statistical measures of the performance of each external clinical criteria

Clinical Criteria	Prevalence (n)	Sensitibity	Specificity	PPV	NPV
Epistaxis (EPI)	54.1% (119)	69%	94%	97%	50%
Ecchymosis (ECH)	20% (44)	26%	98%	98%	30%
Nasal Wound (NW)	41.8% (92)	46%	70%	83%	29%
Airway obstrucction (AO)	15% (33)	19%	96%	94%	27%
Inflammation (INF)	44.5% (98)	56%	92%	96%	40%
Lateral deviation (LD)	14.5% (32)	18%	96%	94%	27%
Irregular nasal dorsum (IND)	23.6% (52)	29%	92%	92%	29%
Septal hematoma (SH)	0.9% (2)	1%	100%	100%	24%
Mean		**33%**	**92.3%**	**94.3%**	**32%**
Fracture	75.9%(167)				

Table 2. Frecuencies distribution and statistical measures of the performance of each external clinical criteria

Clinical Criteria	Prevalence (n)	Sensitibity	Specificity	PPV	NPV
Epistaxis (EPI)	54.1% (119)	69%	94%	97%	50%
Ecchymosis (ECH)	20% (44)	26%	98%	98%	30%
Nasal Wound (NW)	41.8% (92)	46%	70%	83%	29%
Airway obstrucction (AO)	15% (33)	19%	96%	94%	27%
Inflammation (INF)	44.5% (98)	56%	92%	96%	40%
Lateral deviation (LD)	14.5% (32)	18%	96%	94%	27%
Irregular nasal dorsum (IND)	23.6% (52)	29%	92%	92%	29%
Acute septal injury (ASI)	8% (17)	10%	100%	100%	26%
Mean		**38%**	**91%**	**93%**	**33%**

Fracture	75.9%(167)				

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Table 2. Frecuencies distribution and statistical measures of the performance of each double clinical criteria

Clinical Criteria	**Prevalence (n)**	**Sensitibity**	**Specificity**	**PPV**	**NPV**
EPI+ECH	14% (31)	19%	100%	100%	28%
EPI+NW	23% (50)	30%	100%	100%	31%
EPI+AO	12% (26)	10%	100%	100%	27%
EPI+INF	16% (35)	21%	100%	100%	29%
EPI+LD	11% (24)	14%	98%	96%	27%
EPI+IND	17% (37)	22%	98%	97%	28%
EPI+SH	1% (2)	1%	100%	100%	24%
INF+ECH	14% (31)	18%	98%	97%	28%
INF+NW	22% (48)	26%	92%	92%	28%
INF+AO	10% (22)	12%	96%	91%	26%
INF+LD	7% (16)	10%	100%	100%	26%
INF+IND	14% (31)	17%	96%	94%	27%
INF+SH	1% (1)	1%	100%	100%	24%
NW+ECH	10% (21)	12%	98%	95%	26%
NW+AO	7% (15)	8%	96%	87%	25%
NW+ND	5% (11)	7%	100%	100%	25%
NW+IND	13% (29)	16%	96%	93%	27%
NW+SH	1% (2)	1%	100%	100%	24%
IND+ECH	8% (17)	10%	98%	94%	26%
IND+AO	8% (18)	10%	96%	89%	25%

IND+LD	6% (14)	7%	96%	86%	25%
IND+SH	1% (1)	1%	100%	100%	24%
ECH+AO	5% (10)	5%	98%	90%	25%
ECH+ND	3% (6)	4%	100%	100%	25%
ECH+SH	1% (1)	1%	100%	100%	24%
AO+ND	5% (11)	7%	100%	100%	25%
AO+SH	1% (1)	1%	100%	100%	24%
ND+SH	0% (0)	0%	100%	100%	24%
Mean		**10.4%**	**98.4%**	**89.9%**	**25.8%**
Mean for 3 CC		**6.5%**	**100%**	**100%**	**25.2%**

Table 3. Frecuencies distribution and statistical measures of the performance of each external clinical criteria

Clinical Criteria	**Prevalence (n)**	**Sensitibity**	**Specificity**	**PPV**	**NPV**
EPI+ECH	14% (31)	19%	100%	100%	28%
EPI+NW	23% (50)	30%	100%	100%	31%
EPI+AO	12% (26)	10%	100%	100%	27%
EPI+INF	16% (35)	21%	100%	100%	29%
EPI+LD	11% (24)	14%	98%	96%	27%
EPI+IND	17% (37)	22%	98%	97%	28%
INF+ECH	14% (31)	18%	98%	97%	28%
INF+NW	22% (48)	26%	92%	92%	28%
INF+AO	10% (22)	12%	96%	91%	26%
INF+LD	7% (16)	10%	100%	100%	26%
INF+IND	14% (31)	17%	96%	94%	27%
NW+ECH	10% (21)	12%	98%	95%	26%

NW+AO	7% (15)	8%	96%	87%	25%
NW+ND	5% (11)	7%	100%	100%	25%
NW+IND	13% (29)	16%	96%	93%	27%
IND+ECH	8% (17)	10%	98%	94%	26%
IND+AO	8% (18)	10%	96%	89%	25%
IND+LD	6% (14)	7%	96%	86%	25%
ECH+AO	5% (10)	5%	98%	90%	25%
ECH+ND	3% (6)	4%	100%	100%	25%
AO+ND	5% (11)	7%	100%	100%	25%
Mean	**11.5%**	**13.3%**	**97.9%**	**95.3%**	**26.1%**
Mean for 3 CC		**6.5%**	**100%**	**100%**	**25.2%**

Podemos comprobar que no hace falta hacer de entrada una RX de huesos propios y Waters ya que podemos llegar a un Dx clínico de certeza en el 90% de los pacientes en los que hay 2 criterios positivos (VPP), concretamente será del 98 al 100% cuando uno de los criterios clínicos sea la EPI y/o la ECH. Si hay 3 o más CC el diagnóstico clínico sería del 100%.

Los conceptos de sensibilidad y especificidad permiten, por lo tanto, valorar la validez de una prueba diagnóstica. Sin embargo, carecen de utilidad en la práctica clínica. Tanto la sensibilidad como la especificidad proporcionan información acerca de la probabilidad de obtener un resultado concreto (positivo o negativo) en función de la verdadera condición del enfermo con respecto a la enfermedad. Sin embargo, cuando a un paciente se le realiza alguna prueba, el médico carece de información a priori acerca de su verdadero diagnóstico, y más bien la pregunta se plantea en sentido contrario: ante un resultado positivo (negativo) en la prueba, ¿cuál es la probabilidad de que el paciente esté realmente enfermo (sano)?. Así pues, resulta obvio que hasta el momento sólo hemos abordado el problema en una dirección. Por medio de los valores predictivos completaremos esta información

Distribución de S, E, VPP y VPN de los diferentes criterios DX.

Epistaxis (si o no)

	With fracture	Without fracture	Total
with epistaxis	116	3	119
Without epistaxis	51	50	101
Total	167	53	220

Sensibilidad	69%
Especificidad	94%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	97%
Valor predictivo negativo	50%
Chance pretest (odds)	3,15

Wound nasal (si o no)

	With fracture	Without fracture	Total
With nasal wound	76	16	92
Without nasal wound	91	37	128
Total	167	53	220

Sensibilidad	46%
Especificidad	70%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	83%
Valor predictivo negativo	29%

Ecchymosis (si o no)

	With fracture	Without fracture	Total
With ecchymosis	43	1	44

Without ecchymosis	124	52	176
Total	167	53	220

Sensibilidad	26%
Especificidad	98%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	98%
Valor predictivo negativo	30%

Respiración dificultada (A=si ; resto= no)

	With fracture	Without fracture	Total
With airway obstruction	31	2	33
Without airway obstruction	136	51	187
Total	167	53	220

Sensibilidad	19%

Especificidad	96%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	94%
Valor predictivo negativo	27%

Inflammation (si o no)

	With fracture	Without fracture	Total
With inflammation	94	4	98
Without inflammation	73	49	122
Total	167	53	220

Sensibilidad	56%
Especificidad	92%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	96%
Valor predictivo negativo	40%

Lateral deviation (si= LD o LI; resto: no)

	With fracture	Without fracture	Total
With lateral deviation	30	2	32
Without lateral deviation	137	51	188
Total	167	53	220

Sensibilidad	18%
Especificidad	96%
Probabilidad pretest	76%

(Prevalencia)	
Valor predictivo positivo	94%
Valor predictivo negativo	27%

Irregular nasal dorsum (sí= I; resto=no)

	With fracture	Without fracture	Total
with DNI	48	4	52
Without DNI	119	49	168
Total	167	53	220

Sensibilidad	29%
Especificidad	92%
Probabilidad pretest	76%

(Prevalencia)	
Valor predictivo positivo	92%
Valor predictivo negativo	29%

Hematoma septal (Si o no)

	With fracture	Without fracture	Total
With hematoma	2	0	2
Without hematoma	165	53	218
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%

Valor predictivo negativo	24%

Acute septal lession

	With fracture	Without fracture	Total
With	17	0	17
Without	150	53	203
Total	167	53	220

Sensibilidad	10%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	26%

Conclusiones: el dato clínico con mayor S (60%) y VPN (50%) es la epistaxis y las 2 pruebas con mayor especificidad y VPP son la equimosis (98% y 98%) y el hematoma (100% y 100%). Todas salvo la wound nasal, tienen una E y VPP superior al 90%.

Combinaciones de 2 elementos en grupo de 8 ($C_{8,2}$=8!/2!(8-2)!=28

EPISTAXIS

Epistaxis with ecchymosis

	With fracture	Without fracture	Total
With E+E	31	0	31
Without E+E	136	53	189
Total	167	53	220

Sensibilidad	19%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	28%

Epistaxis with nasal wound

	With fracture	Without fracture	Total
With E+H	50	0	50
Without E+H	117	53	170
Total	167	53	220

Sensibilidad	30%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	31%

Epistaxis with airway obstruction nasal

	With fracture	Without fracture	Total
With E+O	26	0	26
Without E+O	141	53	194
Total	167	53	220

Sensibilidad	16%

Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	27%

Epistaxis with inflammation

	With fracture	Without fracture	Total
With E+I	35	0	35
Without E+I	132	53	185
Total	167	53	220

Sensibilidad	21%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo	

negativo	29%

Epistaxis with lateral deviation

	With fracture	Without fracture	Total
With E+L	23	1	24
Without E+L	144	52	
Total	167	53	220

Sensibilidad	14%
Especificidad	98%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	96%
Valor predictivo negativo	27%

Epistaxis with irregular nasal dorsum

	With fracture	Without fracture	Total
With E+D	36	1	37
Without E+D	131	52	183
Total	167	53	220

Sensibilidad	22%
Especificidad	98%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	97%
Valor predictivo negativo	28%

Epistaxis with hematoma

	With fracture	Without fracture	Total
With E+H	2	0	2
Without E+H	165	53	218
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	24%

Epistaxis with asi

	With fracture	Without fracture	Total
With E+ASI	15	0	15
Without E+ASI	152	53	205
Total	167	53	220

Sensibilidad	9%

Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	26%

Conclusiones: la epistaxis sóla es la que tiene más sensibilidad y cuando se combina con cualquiera del resto de síntomas su sensilidad disminuye (≤30%) y la E aumenta a cerca del 100% (100% with ecchymosis, wound, obstrucción nasal, inflammation y hematoma; 98% with lateral deviation y DI)

INFLAMMATION

Inflammation with ecchymosis

	With fracture	Without fracture	Total
With E+D	30	1	31
Without E+D	137	52	189
Total	167	53	220

Sensibilidad	18%
Especificidad	98%

Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	97%
Valor predictivo negativo	28%

Inflammation with nasal wound

	With fracture	Without fracture	Total
WithI+H	44	4	48
Without I+H	123	49	172
Total	167	53	220

Sensibilidad	26%
Especificidad	92%
Probabilidad pretest (Prevalencia)	76%

Valor predictivo positivo	92%
Valor predictivo negativo	28%

Inflammation with Obstruction

	With fracture	Without fracture	Total
WithI+O	20	2	22
Without I+O	147	51	198
Total	167	53	220

Sensibilidad	12%
Especificidad	96%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	91%
Valor predictivo negativo	26%

Inflammation with lateral deviation

	With fracture	Without fracture	Total
With I+L	16	0	16
Without I+L	151	53	204
Total	167	53	220

Sensibilidad	10%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	26%

Inflammation with irregular dorsum

	With fracture	Without fracture	Total
With I+DI	29	2	31
Without I+DI	138	51	189
Total	167	53	220

Sensibilidad	17%
Especificidad	96%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	94%
Valor predictivo negativo	27%
Chance pretest (odds)	3,15

Inflammation with Hematoma septal

	With fracture	Without fracture	Total
WithI+H	1	0	1
Without I+H	166	53	119
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest	76%

(Prevalencia)	
Valor predictivo positivo	100%
Valor predictivo negativo	24%

Inflammation with ISA

	With fracture	Without fracture	Total
With I+ISA	10	0	10
Without I+ISA	157	53	210
Total	167	53	220

Sensibilidad	6%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

Conclusiones: la inflammation sóla es la segunda que que tiene más sensibilidad y VPN (56% y 40%) cuando se combina con cualquiera del resto de síntomas su sensilidad disminuye (≤30%) y la E aumenta a cerca del 100% (100% lateral deviation, epistaxis y hematoma; 98% equimosis y 96% resto salvo wound que es 92%)

WOUND

Criterios clínicos	**Porcentaje (n)**
Epistaxis	**54.1% (119)**
Equimosis	**20% (44)**
Wound	**41.8% (**
Obstrucción	**15% (33)**
Inflammation	**44.5% (98)**
Lateral deviation	**14.5% (32)**
Irregular nasal dorsum	**23.6% (52)**
Hematoma septal	**0.9% (2)**
Fractura	**75.9%(167)**

Wound with ecchymosis

	With fracture	Without fracture	Total
With H+E	20	1	21
Without H+E	147	52	
Total	167	53	220

Sensibilidad	12%
Especificidad	98%

Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	95%
Valor predictivo negativo	26%

Wound with airway obstruction

	With fracture	Without fracture	Total
With H+O	13	2	15
Without L+O	154	51	205
Total	167	53	220

Sensibilidad	8%
Especificidad	96%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	87%

Valor predictivo negativo	25%

Wound withlateorrinia

	With fracture	Without fracture	Total
With H+L	11	0	11
Without H+L	156	53	209
Total	167	53	220

Sensibilidad	7%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

Wound with irregular nasal dorsum

	With fracture	Without fracture	Total
With H+D	27	2	29

Without H+D	140	51	
Total	167	53	220

Sensibilidad	16%
Especificidad	96%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	93%
Valor predictivo negativo	27%

Wound with hematoma septal

	With fracture	Without fracture	Total
With H+HS	2	0	2
Without H+HS	165	53	218
Total	167	53	220

Sensibilidad	1%
Especificidad	100%

Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	24%

Wound with ASI

	With fracture	Without fracture	Total
With H+ASI	8	0	8
Without H+ASI	159	53	212
Total	167	53	220

Sensibilidad	5%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

Conclusiones: la wound sóla es la 3º que tiene más sensibilidad (46%) y cuando se combina con cualquiera del resto de síntomas su sensilidad disminuye (≤30%) y la E aumenta a cerca del 100% (100% con epistaxis, lateral deviation y hematoma; 98% equimosis; 96% obstrucc y DI; 92%inflammation)

IRREGULAR NASAL DORSUM (DNI)

DNI with ecchymosis

	With fracture	Without fracture	Total
With DNI+EQ	16	1	17
Without DNI+EQ	151	52	203
Total	167	53	220

Sensibilidad	10%
Especificidad	98%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	94%
Valor predictivo negativo	26%

DNI with airway obstruction

	With fracture	Without fracture	Total
With DNI+OBS	16	2	18
Without DNI+OBS	151	51	202
Total	167	53	220

Sensibilidad	10%
Especificidad	96%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	89%
Valor predictivo negativo	25%

DNI with lateral deviation

	With fracture	Without fracture	Total
With DNI+LAT	12	2	14
Without DNI+LAT	155	51	206
Total	167	53	220

Sensibilidad	7%
Especificidad	96%

Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	86%
Valor predictivo negativo	25%

DNI with hematoma septal

	With fracture	Without fracture	Total
With DNI+HEM	1	0	1
Without DNI+HEM	166	53	219
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	24%

DNI with asi (ACUTE SEPTAL INJURY)

	With fracture	Without fracture	Total
With DNI+ASI	6	0	6
Without DNI+ASI	161	53	214
Total	167	53	220

Sensibilidad	4%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

EQUIMOSIS (EQ)

EQ with airway obstruction

	With fracture	Without fracture	Total
With EQ+OBS	9	1	10
Without EQ+OBS	158	52	210
Total	167	53	220

Sensibilidad	5%

Especificidad	98%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	90%
Valor predictivo negativo	25%

EQ with lateral deviation

	With fracture	Without fracture	Total
With EQ+LAT	6	0	6
Without EQ+LAT	161	53	214
Total	167	53	220

Sensibilidad	4%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%

Valor predictivo negativo	25%

EQ with hematoma septal

	With fracture	Without fracture	Total
With EQ+HEM	1	0	1
Without EQ+HEM	166	53	219
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	24%

EQ with ASI

	With fracture	Without fracture	Total
With EQ+ASI	4	0	4
Without EQ+ASI	163	53	216
Total	167	53	220

Sensibilidad	2%

Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

OBSTRUCCIÓN (OBS)

OBS with lateral deviation

	With fracture	Without fracture	Total
With OBS+LAT	11	0	11
Without OBS+LAT	156	53	209
Total	167	53	220

Sensibilidad	7%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%

Valor predictivo positivo	100%
Valor predictivo negativo	25%

OBS with hematoma septal

	With fracture	Without fracture	Total
With OBS+HEM	1	0	1
Without OBS+HEM	166	53	219
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	24%

OBS with ASI

	With fracture	Without fracture	Total

With OBS+ASI	5	0	5
Without OBS+ASI	162	53	215
Total	167	53	220

Sensibilidad	3%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

LATERAL DEVIATION (LAT)

LAT with hematoma septal

	With fracture	Without fracture	Total
With LAT+HEM	0	0	0
Without LAT+HEM	167	53	220
Total	167	53	220

LAT with ASI

	With fracture	Without fracture	Total

With LAT+ASI	5	0	5
Without LAT+ASI	162	53	215
Total	167	53	220

Sensibilidad	3%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	25%

Combinaciones de 3 elementos en grupo de 8 ($C_{8,3}$=8!/3!(8-3)!=56

EPISTAXIS+WOUND+INFLAMMATION

	With fracture	Without fracture	Total
With EP+HER+IN	35	0	35
Without EP+HER+IN	132	53	185
Total	167	53	220

Sensibilidad	21%

Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	29%

EPISTAXIS+WOUND+DNI

	With fracture	Without fracture	Total
With	19	0	19
Without	143	53	201
Total	167	53	220

Sensibilidad	12%
Especificidad	100%
Probabilidad pretest (Prevalencia)	75%
Valor predictivo positivo	100%

Valor predictivo Negativo	27%

EPISTAXIS+WOUND+ECH

	With fracture	Without fracture	Total
With	14	0	14
Without	153	53	206
Total	167	53	220

Sensibilidad	8%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	26%

EPISTAXIS+ECH+OBST

	With fracture	Without fracture	Total
With	6	0	6

Without	161	53	214
Total	167	53	220

Sensibilidad	4%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	25%

EPISTAXIS+ECH+INFL

	With fracture	Without fracture	Total
With	23	0	23
Without	144	53	197
Total	167	53	220

Sensibilidad	14%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%

Valor predictivo positivo	100%
Valor predictivo Negativo	27%

EPISTAXIS+ECH+LAT

	With fracture	Without fracture	Total
With	3	0	3
Without	164	53	217
Total	167	53	220

Sensibilidad	2%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	24%

EPISTAXIS+ECH+DNI

	With fracture	Without fracture	Total
With	12	0	12
Without	155	53	208
Total	167	53	220

Sensibilidad	7%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	25%

EPISTAXIS+ECH+HEMAT

	With fracture	Without fracture	Total
With	1	0	1
Without	166	53	119
Total	167	53	220

Sensibilidad	1%
Especificidad	100%

Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	24%

EPISTAXIS+HER+OBSTR

	With fracture	Without fracture	Total
With	1	0	1
Without	166	53	219
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo	

Negativo	24%

EPISTAXIS+HER+LAT

	With fracture	Without fracture	Total
With	1	0	1
Without	166	53	219
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	24%

EPISTAXIS+HER+HEMAT

	With fracture	Without fracture	Total
With	1	0	1
Without	166	53	219
Total	167	53	220

Sensibilidad	1%

Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	24%

EPISTAXIS+HER+ASI

	With fracture	Without fracture	Total
With	8	0	8
Without	159	53	212
Total	167	53	220

Sensibilidad	5%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%

Valor predictivo Negativo	25%

EPISTAXIS+INF+ASI

	With fracture	Without fracture	Total
With	8	0	8
Without	159	53	212
Total	167	53	220

Sensibilidad	5%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo Negativo	25%

EPISTAXIS+ECH+ASI

	With fracture	Without fracture	Total
With	4	0	4

Without	163	53	212
Total	167	53	220

Sensibilidad	2%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

Meter variables clínicas with poca frecuencia de presentación no ofrece ventajas cuando hemos alcanzado el 100 de VPP ya que lo único que hace es bajar la sensibilidad y VPN. Así si metemos el irregular nasal dorsum que es el 4º criterio más frecuente de presentación:

	With fracture	Without fracture	Total
With EP+HER+IN+DI	12	0	12
Without EP+HER+IN+DI	155	53	208
Total	167	53	220

Sensibilidad	7%

Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	25%

Si además metiéramos el 5º criterio en frecuencia de presentación (equimosis):

	With fracture	Without fracture	Total
With EP+HER+IN+DI+EQ	3	0	3
Without EP+HER+IN+DI+EQ	164	51	217
Total	167	53	220

Sensibilidad	2%
Especificidad	100%
Probabilidad pretest (Prevalencia)	77%
Valor predictivo positivo	100%

Valor predictivo negativo	24%

Así podríamos llegar al 0% de sensibilidad y VPN. Pongamos como ejemplo añadir a este grupo el Hematoma septal:

	With fracture	Without fracture	Total
With EP+HER+IN+HS	1	0	1
Without EP+HER+IN+HS	166	53	119
Total	167	53	220

Sensibilidad	1%
Especificidad	100%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	100%
Valor predictivo negativo	24%

	With fracture	Without fracture	Total

With EP+HER+IN+DI+HS	0	12	12
Without EP+HER+IN+DI+HS	167	41	208
Total	167	53	220

Sensibilidad	0%
Especificidad	77%
Probabilidad pretest (Prevalencia)	76%
Valor predictivo positivo	0%
Valor predictivo negativo	20%