UDC: 61 **ISSN 1409-9837**

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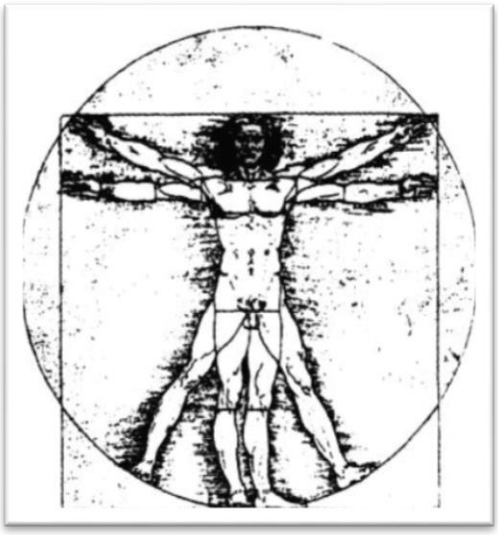

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ACTA MORPHOLOGICA

INTERNATIONAL JOURNAL OF THE MACEDONIAN ASSOCIATION
OF ANATOMISTS AND MORPHOLOGISTS

Vol. 14 (2) 2017

ACTA MORPHOLOGICA
International Journal of the Macedonian Association of Anatomists and Morphologists (MAAM)
Member of the European Federation of Experimental Morphology (EFEM)
Member of the International Symposium of Morphological Sciences (ISMS)

Published
Twice a year

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UDC: 616.34-002-089.87-06

ORIGINAL ARTICLE

HISTOLOGICAL POSITIVITY OF RESECTION MARGINS AS RISK FACTOR FOR OCCURRENCE OF EARLY POSTOPERATIVE COMPLICATIONS IN PATIENTS UNDERGOING ILEOCOLIC RESECTION DUE TO COMPLICATIONS FROM CROHN'S DISEASE

Joksimovic Vladimir [1], Jankulovski N[1], Antovic S[1], Manceva Lj[2], Joksimovic M[3], Karagjozov P[1]

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ABSTRACT

Crohn's disease (CD) is a chronic inflammatory condition of the gastrointestinal tract that can lead to strictures, inflammatory masses, fistulas, abscesses, hemorrhage and cancer. This disease commonly affects the small bowel, colon, rectum or anus. Less commonly, it affects the stomach, esophagus and mouth. Often, the disease affects multiple areas of the gastrointestinal tract simultaneously. The cause of CD is not known and there is no curative treatment. Current medical and surgical treatments are effective in controlling the disease, but even with optimal treatment, recurrences and relapses are frequent.

Various risk factors specific for the patients with conditions related to the CD can influence the outcome of the surgical treatment in the postoperative period. Those risk factors can be preoperative laboratory markers of inflammation such as WBC and CRP values, phlegmona of the anterior abdominal wall, preoperative interintestinal abscess and positive resection margins.

We present our initial 5-year results of the Clinic for Digestive Surgery in Skopje, regarding the impact of histological resection margins on the emergence of the early postoperative complications in patients undergoing ileocolic resection due to Crohn's disease. The statistical program SPSS 19.0 was used for quantitative analysis and processing of the data. All statistically significant differences were discussed at a statistically significant level of $p < 0.05$

Keywords: Crohn's disease, risk factors, complications.

INTRODUCTION

Crohn's disease (CD) is a chronic inflammatory disease of the gastrointestinal tract (GIT), which may occur anywhere from the mouth to the anus. Its usual presentation includes strictures, fistulas, abscess, perforations, bleeding and carcinoma. Most often CD appears first is in the small intestine, especially in the terminal ileum and rarely in other parts of GIT. Despite significant progress in the medical treatment of CD, most patients eventually require surgery. The combined approach in the treatment including drug treatment and timely surgical intervention [1], is the optimal treatment of this disease, thereby improving the quality of patient's life and reducing the costs of treatment [2].

Recommended indications for surgical treatment proposed by the American Society of Colorectal Surgery (American Society of Colon and Rectal Surgeons – ASCRS) include the following:

• Persistent symptoms despite high-dose corticosteroid therapy

•Complication such as:

- Intraabdominal abscesses
- Fistulae
- Fibrous stricture with obstructive symptoms
- Toxic megacolon
- Intractable hemorrhage
- Perforations
- Malignancy

Nearly 70–90% of Crohn's disease patients will undergo at least one operation during the course of CD [3,4]. Intestinal resection (ileocolic) and surgery for perianal fistulas are the most common procedures.

Patients with CD have a higher rate of postoperative complications especially anastomotic complications that lead to sepsis, unlike all other patients undergoing abdominal surgery due to non-inflammatory disease. There are numerous risk factors cited for occurrence of the complications, especially for intraabdominal septic complications (IASC). Some of these are peri-operative hypoalbuminemia, anemia, and leukocytosis [5,6]. Also the use of preoperative corticosteroids has been demonstrated to contribute to postoperative IASCs [5, 7, 8, 9, 10]. Postoperative septic complications, including anastomotic leakages, enterocutaneous fistulae, and intraabdominal abscesses, are especially troublesome, with incidence rates ranging between 5% and 20% [9-11], and are often the underlying causes of death following surgery [5]. The incidence of postoperative IASCs would reduce to 14% if one, or 6% if no risk factors were present [11].

According to Fasio et al. [12] positive resection margins on the postoperative histopathological analysis affect the occurrence of postoperative complications and so do the duration of preoperative symptoms, poor nutritional status, etc. Also, according to Pennington et al. [13] and Shental et al. [14] there are certain intraoperative risk factors that have an impact on the occurrence of postoperative complications as following: indication for surgery, intraoperative diagnosis, type of surgery, positive resection margins.

This study focuses precisely on histological positivity on resection margins as risk factor for occurrence of early postoperative complications in patients undergoing ileocolic resection for Crohn's disease.

The aim of this paper is to present the results obtained at the Clinic for Digestive Surgery in Skopje during a 5-year period and to indicate the correlation between histological positivity of resection margins with development of early postoperative complications (complications that occur 30 days postoperatively). The study included determination of the number of patients treated surgically due to Crohn's disease and the trend of its movement in our population (in the 5-year period). It was also our aim to determine the rate of early postoperative complications, especially IASC's in our population and its trend in the 5-year reviewed material.

MATERIALS AND METHODS

This is an analytical study which was performed at the Clinic for Digestive Surgery at the University Clinical Centre of Skopje, Macedonia. The study included 59 patients in the 5-year period (2013-2017) and all of them had on operation due to CD complications or poor response to drug therapy. The surgical procedures, which were performed in all of the patients,

were right hemicolectomy and right abbreviated hemicolectomy with ileocecal, ileo-coloascendo or ileotransverse anastomosis. The type of anastomosis (termino-terminal, termino-lateral and latero-lateral) was not evaluated. All of the anastomoses were hand sewn in one or two layers.

Patients were divided into two groups: a group of patients who experienced early postoperative complications and a group of patients without postoperative complications.
In terms of abdominal postoperative complications the following were observed:

1. postoperative abdominal abscesses,
2. anastomotic lekage,
3."Platz-bauch",
4. enterocutaneous fistula,
5. wound infections.

We also examined the resection margins of the resected bowel of all 59 patients. The pathological examinations were performed in the same pathological laboratory for verifying the presence of inflammation on the resection margin of the intestine. There was a consistency in the assessment of the specimens by using the same methods and by evaluation of the same parameters in all cases. All data were divided in three groups 1. negative margins, 2. partial positive margins where the ileal margin was positive and 3. fully positive margins.

The statistical program SPSS 19.0 was used for statistical analysis. All statistically significant differences were discussed at a statistically significant level of $p < 0.05$.

RESULTS

During the 5-year period, 59 patients were operated on at the University Clinic for Digestive Surgery for the Crohn's disease complications (Figure 1).

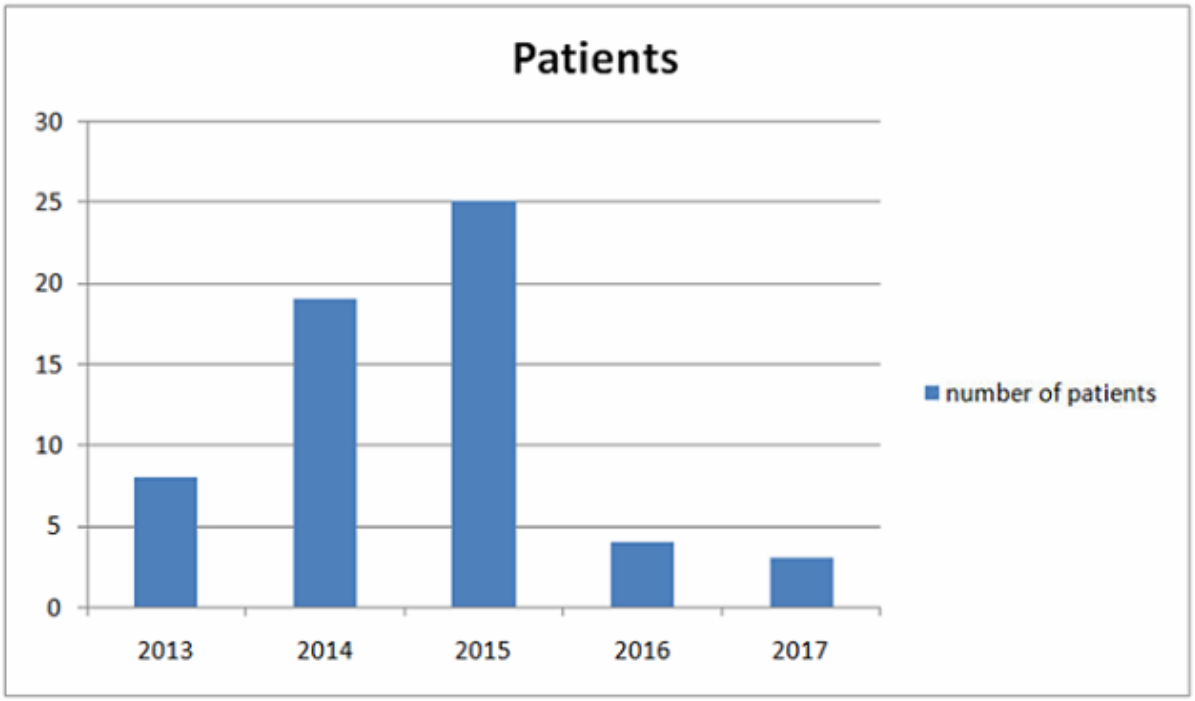

Fig. 1. Number of operated patients from 2013 to 2017.

Thirty-four (57.6%) of them were male while 25 (42.3%) were female (Figure 2).

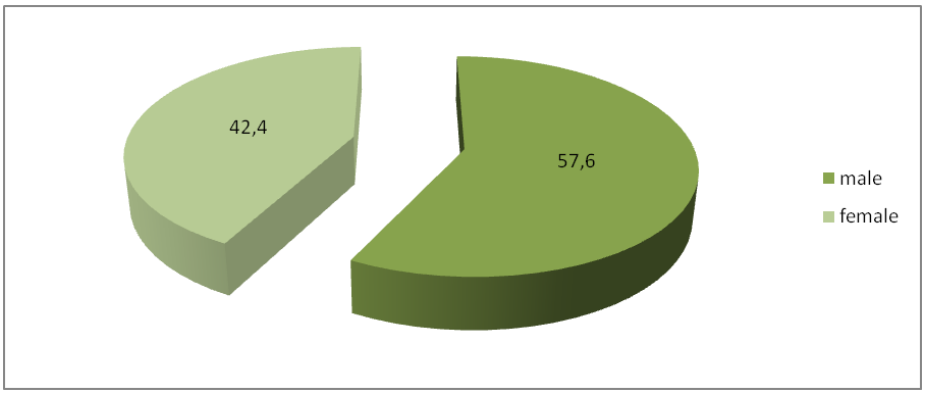

Fig. 2. Presentation of patients according to sex.

We analyzed the microscopic presence of inflammation on the resection margins of the bowel in terms of fully positive where both margins were with signs of inflammation, partial positive margins meaning only one positive margin (terminal ileum) and negative margins. We compared these results with development of an IASC or other postoperative complications.

From all 59 patients, 22 (37%) developed postoperative complications, and from these 14 (23%) experienced IASC while 37 (63%) patients had no postoperative complications (Figure 3), $p < 0.05$ ($p = 0.002$, Difference test).

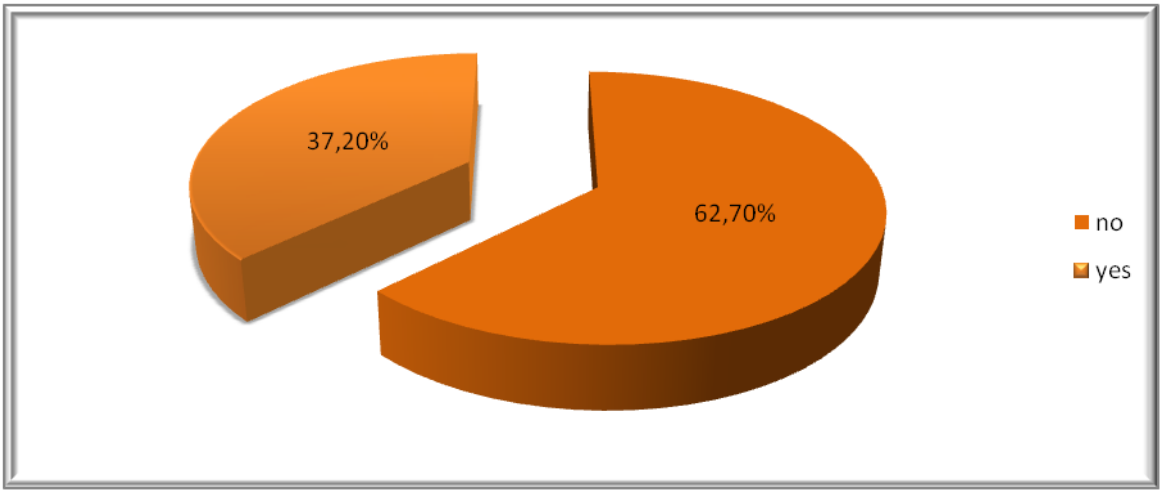

Fig. 3. Presentation of patients according to complications.

Regarding resection margins, in 27 (45%) cases positive or partly positive margins were found. Of these 10 (17%) patients had two positive margins, while 17 (28%) had partially positive margins (Table 1), $p < 0.05$ ($p = 0.03615$, Difference test).

Table 1. Presentation of patients according to resection margins

Resection margins	Number	%
no	32	54.2
yes	27	45.8

Complications occurred in 100% of patients in the group with positive resection margins, partial or full (Figure 4).

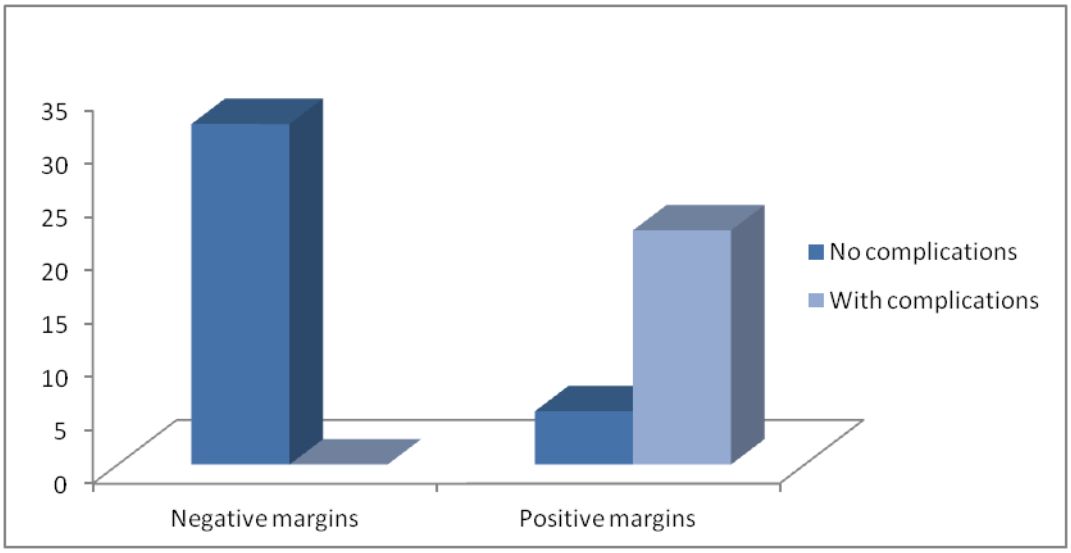

Fig. 4. Comparison of histological margins and postoperative complications.

From 10 patients with both positive resection margins, 7 (70%) experienced complications and 6 of them had dehiscence of the anastomosis and 1 had a platzbauch. From 17 patients with one positive resection margin, 15 (88%) had postoperative complications, of whom 8 had dehiscence of the anastomosis, 4 had platzbauch and 3 had wound infection (Table 2).

Table 2. Type of experienced complication and comparison with histological margins

Histological margins	Dehiscence of ileo-ascendo-anastomosis	Dehiscence of ileotransverse anastomosis	Dehiscence of ileocecal anastomosis	Platzbauch	Wound infection
+ +	5	1	0	1	0
+ -	4	3	1	4	3

In the period of 5 years, there was only 1 patient with adenocarcinoma of the colon due to Crohn's disease, as well as 2 lethal cases due to perforation of the intestine with peritonitis and respiratory failure. Regarding the annual distribution of complications over the years (2013-2017) higher peak complications that required surgery due to complications of Crohn's disease were observed in 2014 and 2015 (Figure 1).

DISCUSSION

It is already well-known from previous studies that operations performed in patients with Crohn's disease entail a markedly high risk for IASC [5, 15], most probably because of the inflammatory nature and poor wound healing associated with the disease, as well as the decreased nutritional status of many patients with Crohn's disease who require surgical intervention [8, 16, 17, 18]. In the current study the overall incidence of 30-day IASCs following ileocolonic resection was 23% (n = 14), and there were two postoperative deaths. Currently there is no literature to provide the standard incidence of postoperative IASCs; however, these rates are similar to those of previous studies, which reported rates of IASC in the range of 5% to 20% [4, 5, 9].

Furthermore, this study has confirmed that microscopically positive margins are one of the risk factors for developing IASC and other complications. Concerning this issue, there are conflicting results in the literature. One study found histological positive margins to be an independent risk factor for IASC [13], while another study found no increased risk of IASC with inflammation present at the margins [19]. In our study there is an absolute connection between presence of the inflammation process on the intestine margin, which is used for creating anastomosis and manifestation of IASCs or other complications. But, the limitations of this study are not taking into consideration the other risk factors and the relatively small number of included patients.

Therefore, more studies are needed that will compare and analyze all risk faktors and determine the risk factors for the occurrence of early postoperative complications in patients operated due to complications from CD. One multicentric study is that of Yamamoto et al. [5], which analyzed the risk factors that affected the occurrence of complications in patients operated due to Crohn's disease. Also, a recent study by Kanazawa et al. [14] has indicated the association of multiple risk factors in the occurrence of postoperative septic complications.

CONCLUSION

In conclusion, there is a correlation between the histological positivity of resection margins with development of early postoperative complications. Although there is statistical significance in the correlation between histological margins and the occurrence of early postoperative complications, one has to take into account other risk factors such as interintestinal abscesses, hypoproteinemia and hypoalbuminemia, type of surgery (emergency vs. elective) and type of treatment which all affect the occurrence of early postoperative complications.

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UDC: 616.31-084:613.263]:616.316-008.8

ORIGINAL ARTICLE

SALIVARY AND PLAQUE pH VALUES RESPONSE TO THE POLYOL SUCROSE SUBSTITUTES IMPACT

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ABSTRACT

Acido-base homeostasis is part of human homeostasis and refers to the correct ratio between the acids and bases or sustaining a set pH factor value in intracellular and extracellular fluids and tissues. The pH scale values are in the range of 0-14 and the distribution of the values is exponential. Consequently, even the smallest variations of those values cause meaningful alterations in the rate of the cell chemical reactions. Oral homeostasis is maintained at the pH value of 6,8-7,2 on all levels-saliva and dental plaque. In the state of persistent uncontrolled intake of easily fermented carbohydrates, insufficient and incorrect oral hygiene, the oral pH degrades to the critical levels of 5,5, initiating DEM that commonly surpasses REM, therefore creating conditions for caries initiation. With the actualization of the xylitol as a sucrose substitute and possible caries preventive agent, we create the goal for our study, to evaluate the pH value changes on the salivary and plaque levels in conditions of habitual xylitol use. Xylitol use was supplied with a 10% xylitol solution, both in examine group and the control group used 10% sorbitol solutions, with daily intake 9 gr. Salivary pH values were determined by testing saliva samples with a standard pH meter, in time of 6 months. Dental plaque pH values was determined in situ, using Beetrode $NMPHL_3$ microelectrode. The results show significant increase the pH values in both mediums ($p<0,001$), in saliva 6,46-6,95 and in dental plaque 6,27-6,9, in xylitol examine group. Maintaining a high pH values on salivary and plaque levels, xylitol significantly benefits dental caries prevention.

Keywords: xylitol, saliva, dental plaque, pH values, caries preventive.

INTRODUCTION

Acido-base homeostasis is part of the human homeostasis and refers to the correct ratio between the acids and bases or sustaining a set pH factor value in intracellular and extracellular fluids and tissues. It is in direct correlation with the H+ ion value in the previously mentioned segments. The pH scale values are in the range of 0-14 and the distribution of the values is exponential. Consequently, even the smallest variations of those values cause meaningful alterations in the rate of the cell chemical reactions. Oral homeostasis is maintained at the pH value of 6,8-7,2 on all levels (saliva and dental plaque). Maintaining approximately constant levels of pH on both oral and cellular stratum is due to the function of the buffer systems, which exponentiate their impact in the state of acidity or alkalinity - they are the body's resistance towards the change of the pH value.

In the oral medium, on a salivary level, there are three buffer systems-bicarbonate, protein and phosphate, from which, the bicarbonate has the most eminent role. pH value of

the oral medium is kept at the minimal point of 6,3 to ensure the integrity of the dental structures.

In the act of consuming food, especially sucrose, there is a decrease of the pHvalue and increase in the bicarbonate concentration, followed by the increased salivary flow. The decrease in pH value is caused by the enlarged concentrations of H+ ions in the plaque, due to creating acidic products from the bacterial carbohydrate metabolism (Stefan's curve explains that there is a 40-minute period needed for neutralizing an acidic episode) in order to activate the process of natural remineralization.

In the state of persistent uncontrolled intake of easily fermented carbohydrates, insufficient and incorrect oral hygiene, the oral pH degrades to the critical level of 5,5-5,0 initiating demineralization that commonly surpasses the remineralization, therefore creating conditions for caries initiation.

High caries scores present in large numbers of the population, especially in children (DMF=6,88), makes it a challenge to find a method or medium which will assist in quality conditioning the oral medium resistance to such challenges and assist in the natural remineralization process.

Knowing that the carbohydrates are the number 1 cause for disrupting the oral homeostasis, it is natural to search for a substance that is not a carbohydrate, but has the same sweetening nature, and can contribute to maintaining the oral acid-base balance. With the actualization of the xylitol as a sucrose substitute and possible caries protective agent, created the possibility for evaluating its impact and effect on different levels in the oral medium. Thus, the goal of our study was created.

The aim of the study to evaluating the pH value changes on the salivary and plaque levels in conditions of habitual xylitol use.

MATERIALS AND METHODS

To answer these questions, we conducted our research in the suggested selective mediums, in which the xylitol influence can be evaluated adequately. Aiming to gain the most valid data on the influence of the xylitol active substance, its use was supplied with a 10% xylitol solution with aqua pro injection, as suggested by Muhlemann. Using this sterile, apyrogenic water guarantees its absolutely neutral relation in the oral medium, therefore, underlining only the xylitol effect. The active component is Xylitol (U-14 C) xylitol Fischer Chemicals. The solution is prepared ex tempore, and its stability is verified on HPLC (High Performance Liquid Chromatography), on the Faculty of Pharmacy in Skopje. The control group used 10% sorbitol solutions. Daily intake of both sucrose substitutes was 9 grams. Water solution application was conducted daily, three times a day, after every major meal, in a quantity of 10 cm^3, over a 30 second time period. Application duration lasted six months, during which, apart from the basic, three more tests were conducted - one month after, six months after and six months after cessation of use. On the last analysis, we followed the salivary pH value to evaluate the eventual protracted polyol effect.

The investigated population contained 60 subjects aged between 15-18, and the control contained 30. The investigated group got rinse solutions with xylitol, the control got sorbitol.

Salivary pH values were determined by testing saliva samples with a standard pH meter.

Dental plaque pH values were determined in situ, using Beetrode $NMPHL_3$ microelectrode, and was conducted on buccal and interdental surfaces, at the start of every control seance. This research is undertaken to determine subtle changes in the plaque pH values.

RESULTS

Table 1 and figure 1 shows the results of the t-test of the significance of differences in salivary pH values, both in examine and control group, before, one month after application of 10% xylitol and sorbitol solutions, and 6 months after application. It is evidence that there are the significant difference for (p<0,001). The results are better in the examine xylitol group, versus sorbitol (control) group.

Table 1. Salivary pH values/ differences – xylitol

Parameter	T-test for dependent samples		
	t-value	p-level	significance
Basic/ I control	5.223	0.00001	Sig.
I control/ II control	1.893	0.0632	Sig.
Basic/ II control	3.552	0.0012	Sig.
	Analysis of Variance		
Basic/ I control/ II control	F=11.29	p=0.00002	Sig.

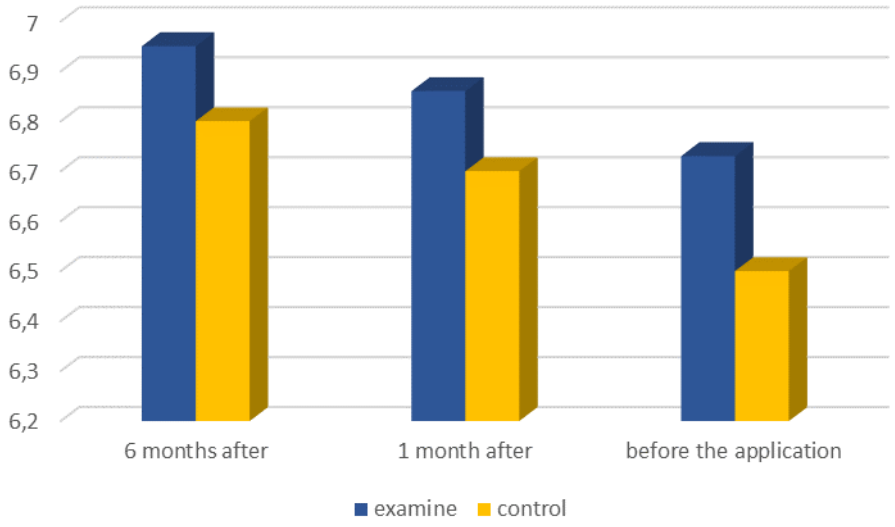

Fig. 1. Change of salivary pH in research periods /average values/.

Table 2 and figure 2 shows the results of the t-test of the significance of differences in plaque pH values, both in examine and control group, before, one month after application of 10% xylitol and sorbitol solutions, and 6 months after application. It is evidence that there are the significant difference for (p<0,001). The results are better in the examine xylitol group, versus sorbitol (control) group.

Table 2. Plaque pH values / differences – xylitol

Parameter	T-test for dependent samples		
	t-value	p-level	significance
Basic/ I control	10.621	0.00000	Sig.
I control/ II control	12.904	0.00000	Sig.
Basic/ II control	17.377	0.00000	Sig.
	Analysis of Variance		
Basic/ I control/ II control	F=28.848	p=0.000	Sig.

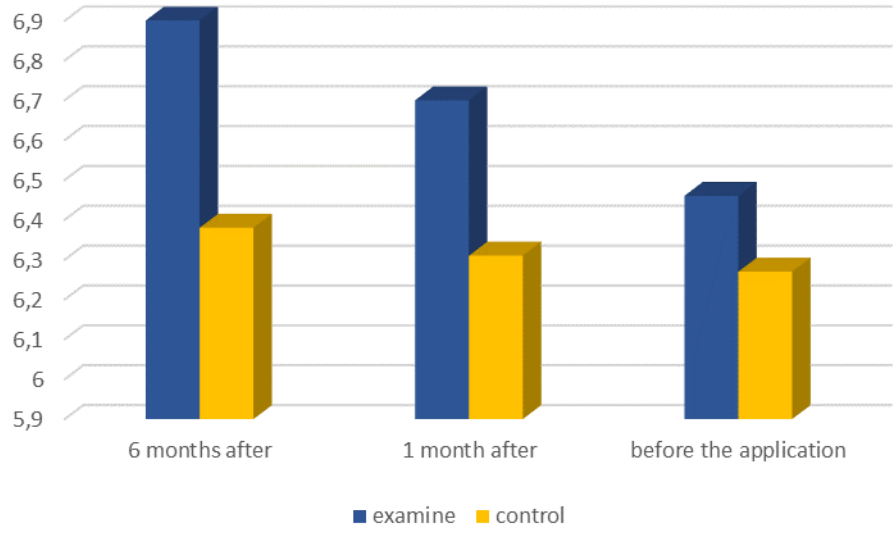

Fig. 2. Change of plaque pH in research periods /average values/.

DISCUSSION

Evaluating plaque and salivary pH demands significant place, as in our research, thus in studies conducted by other authors, which directed their research towards evaluation the preventive aspects of sugary alcohols action as sucrose substitutes. In these studies, the main accent was on the xylitol action. The aspect of these significantly important parameters is related to their positive or negative change, which would be a consequence of the eventual polyol effect over the plaque and salivary acidity.

Aquire-Zero et al. [1], inform that xylitol chewing gum use, compared to sucrose, sorbitol chewing gum or without them, results with significantly increased plaque pH values. Furthermore, minimal pH values are increased, and the zone in which the curve noting pH values under 6 is significantly smaller. This indicates the fact that the chances of a significant drop in this value are decreased, thus lowering the possibility to create demineralization

conditions. This also means that the acidogenic potential of the dental plaque is decreased [1]. The results stated are directly comparable with the findings of our study, because the measurements were conducted with the Beetrode electrode, the same used in our measurements.

Muhlemann et al. [2] state that pH values in the range of 4.0 - 4.5 regularly occur after rinsing with sucrose solutions, indication an optimal function of the plaque pH and the pH recording system. Plaque pH measured after rinsing with a 10% xylitol solution ranges between 6.50 - 6.75. These findings are similar to ours, the plaque pH after a month of xylitol use ranges around 6.7, and after a six-month use reaches its maximum of 6.902. Significant in relation to the known parameters.

Findings from the previously indicated study from Aquirre-Zero et al. [1] are in accordance to the Soderling et al. [3] findings, stating that xylitol chewing gum can provide a better effect than those with sorbitol. Lowered acid production creates a lower enamel demineralization chance and a sped up neutral salivary pH values restoration, which can favorize the remineralization process. This way, the relative small differences in the pH decreased plaque potential can, over a longer period of time, be used in the clinically relevant reduction of caries potential [3].

Some studies state that xylitol causes no plaque pH reduction nor in vivo nor in vitro. In clean cultures, xylitol inhibits growth and acid production of some oral bacteria. Results from acid productions studies using xylitol mixtures and other carbohydrates are somewhat controversial. For example, xylitol produces a fall in acid production in the plaque when used simultaneously with glucose or fructose. Other studies demonstrate data for a much smaller or nonexistent inhibitory effect on acid production by xylitol in mixtures of xylitol and sucrose. Our results are concordant to those that state that xylitol gives an unclear inhibitory effect on acid production from a mixed oral flora when used in combination with fermentable carbohydrates. Soderling et al. [3] estimate that acid production decrease is explained by forming a xylitol 5 phosphate in some oral bacteria, for example, bacteria from the Str. mutans strain, which is a toxic aggregate for them.

Results from the Michigan study suggest that biweekly xylitol chewing gum use, changes the plaque usefully, meaning its ability to be resistant to a plaque pH drops, which normally follows after exposing the plaque to sucrose solutions [4]. Sassaki et al. [5] note xylitol as an agent which inhibits acid production instead of, for example, sorbitol.

Lingstrom et al. [6] state that results from the study dedicated to evaluating the effect of xylitol solution rinsing and isomaltulose (palatinose) solutions. Statistically significant changes are found in the actual pH values ($p<0.05$ in 10, 20, 30 min.). Values range between 6.8 in the first minute to 6.2 in the 30th minute for xylitol and from 6.6 to 6.1 in the 10th minute and to 6.2 in the 30th minute for palatinose. Xylitol pH values are constant, beginning in the 5th minute.

That Xylitol significantly influences the plaque and saliva pH, ascertains Trahan, which is in accordance to our results [7].

Ribelles Liop et al. [8] referred that comparison of salivary flow rates revealed no statistically significant differences ($p>0,5$), though salivary flow and the resulting recovery of pH levels and reduction of levels of Str. mutans in saliva. Janakiram, et al. [9], in 2017 noticed that xylitol was found to be an effective strategy as self-applied preventive agent.

Kumar et al. [10], in their study dedicated to the comparative evaluation of the effects of xylitol and sugar free chewing gums on salivary and dental plaque pH in children, noticed that, children consuming the sugar-free (xylitol) chewing gums showed a marked increase in the pH of saliva and plaque when compared to their counterpart. All these values had a significant difference of $p<0,0001$. Xylitol is a safe all-natural sweetener which helps to reduce tooth decay. It plays a unique role in preventive strategies for better health.

CONCLUSION

1. Salivary pH values show significant differences in both groups during the whole research period, meaning a continuous increase in values from 6.73 on the basic measurement to 6.95 at the end of the research period, after a six-month xylitol solution application. Maintaining such salivary pH values shows a quality oral balance thanks to the xylitol effect. ($p<0.001$).

2. Plaque pH values range around normal levels, however, the xylitol group, starting from the basic level with a pH 6.46, at the end of the research period after a six-month application, the pH values grew to 6.9, which supports a xylitol strong caries protective effect.

3. Maintaining a quality condition in the oral medium on salivary and plaque levels significantly benefits dental caries prevention.

4. The fact originating from the results of our study favorizes xylitol as a sucrose substitute which has no harmful effects on the oral medium, enables conditioning the cavum and minimizes the risk of initiating dental caries.

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UDC: 616.447-008.61-073.916

CASE REPORT

ABSENT THYROID UPTAKE DURING PLANAR ^{99M}TC MIBI PARATHYROID SCINTIGRAPHY

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ABSTRACT

The aim of this case report is to describe the unusual pattern of technetium-99m methoxyisobutylisonitrile (^{99m}Tc-MIBI) biodistribution during parathyroid scintigraphy.

A 37-year-old female patient was referred to our Department for parathyroid scintigraphy because of signs of osteoporosis and laboratory findings suggesting hyperparathyroidism. She had no other chronic disease or condition. The serum ionized calcium levels (1.43 mmol/L) and PTH levels (140.1 pg/ml) were above normal. The tests for thyroid function (FT4, FT3, TSH, thyroid peroxidase and thyroglobulin antibodies) were within normal range. The ultrasound revealed normal sized thyroid with isoechoic structure. On the posterior side of the thyroid at the lower pole of the left lobe hypoechoic nodule was present with dimensions 8x10x17 mm. The node was interpreted as parathyroid adenoma. The patient took no medications or supplements prior and at the time of scintigraphy.

Parathyroid scintigraphy was performed after intravenous injection of 740 MBq ^{99m}Tc-MIBI. Early scan was obtained 10 minutes after injection with planar gamma camera in AP view. Late planar scan was obtained 2 hours after injection. The early and late planar scintigraphy revealed increased uptake in the region below the thyroid bed on the left consistent with parathyroid adenoma. The unusual finding was a complete absence of ^{99m}Tc-MIBI uptake in the thyroid gland during both, early and late planar scintigraphy. The uptake in the salivary glands and the heart was normal. We could not find any plausible explanation for this very low ^{99m}Tc-MIBI uptake in the thyroid that was not visible during the early and late planar scans. The altered biodistribution of ^{99m}Tc-MIBI in otherwise normal thyroid is a possibility that one should be aware of during the interpretation of parathyroid scintigraphy.

Keywords: parathyroid scintigraphy, MIBI, thyroid, low uptake, hyperparathyroidism.

INTRODUCTION

Primary hyperparathyroidism is a disorder caused by excess amounts of parathyroid hormone in the bloodstream due to enlargement of one or more than one of the parathyroid glands. These patients may have increased serum calcium level and decreased level of serum inorganic phosphates [1]. Various scintigraphic protocols have been proposed to distinguish parathyroid from thyroid uptake and to identify and locate abnormal parathyroid glands: ^{99m}Tc-MIBI Dual-Phase Protocol, ^{99m}Tc-MIBI and $^{99m}TcO_4^-$ comparison, ^{99m}Tc-MIBI and ^{123}I simultaneous acquisition with subtraction and single-photon emission computed tomography (SPECT) protocol [2]. Taillefer R *et al*. recommended the use of a single-isotope dual-phase (early- and delayed-phase) scintigraphic technique, a suggestion based on their observation that ^{99m}Tc-MIBI washes out more rapidly from the thyroid gland than from hyperfunctioning parathyroid glands [3]. ^{99m}Tc-MIBI is a lipophilic cationic complex and its molecules are distributed according to the flow of the blood through the vessels in the body; the movement

continues across the cell membranes by passive diffusion, and becomes concentrated intracellularly in the region of the mitochondria. Arbab et al. explained that detectability of parathyroid adenomas and hyperplastic parathyroid glands is related to the presence of mitochondria-rich oxyphil cells [4]. Tc^{99}m-MIBI initially accumulates in normal thyroid tissue, thyroid adenomas, thyroid carcinomas, parathyroid adenomas, and hyperplastic parathyroid glands. The radiotracer accumulation in normal thyroid tissue significantly reduces with time compared to parathyroid adenomas where the activity is more intense than the thyroid on the early images and the washout is slower on the delayed images [5]. The knowledge of the possible variations of biodistribution of ^{99m}Tc-MIBI in the thyroid is very important during interpretation of parathyroid scintigraphy. This report presents a case with an unusual pattern of ^{99m}Tc-MIBI biodistribution during parathyroid scintigraphy in a patient with suspected primary hyperthyroidism with almost absent uptake in the thyroid tissue during the early phase of the study.

CASE PRESENTATION

A 37-year-old female patient with signs of osteoporosis and laboratory findings suggesting hyperparathyroidism was referred to the Nuclear Medicine Department to undergo evaluation for a possible parathyroid adenoma. During the physical examination, the neck was normal on palpation. Her medical and family histories were not significant. A neck ultrasound was performed and revealed a normal sized and shaped contour of the thyroid with isoechoic, homogenous appearance. A hypoechoic mass 8x10x17 mm was noted, suspected of being a parathyroid adenoma. This nodule was located on the posterior side of the thyroid at the lower pole of the left lobe. Blood examination showed elevated parathormone (PTH) level (140 pg/ml) (normal range: 11–62 pg/ml) and increased level of serum ionized calcium levels (1.43mmol/L) (normal range 1.12-1.32 mmol/L). However, other parameters such as tests for thyroid function were all within their normal range: thyroid-stimulating hormone: 1.5 μU/ml, free triiodothyronine (FT3): 6.97 pmol/ml, free thyroxine (FT4): 14.0 pmol/ml, aTPO 14.6 U/ml, aTG<20 U/ml. To clarify the cause of primary hyperparathyroidism, dual-phase single isotope parathyroid scintigraphy technique was performed. The patient was given an intravenous dose of 740 MBq ^{99m}Tc-MIBI, followed by early images at 10 minutes after injection and delayed images of the neck, 2 hours later. Planar images were obtained with planar gamma camera in AP view (MEDISO, Nucline) with general purpose collimator and 128x128 matrix. Scintigraphy revealed a focus of intense radiopharmaceutical retention in the region below the thyroid bed during both, early and late acquisition phase, which was consistent with parathyroid adenoma. The accumulation of the radiopharmaceutical corresponded to the sonographic finding. The unusual finding was the absence of ^{99m}Tc-MIBI uptake in the thyroid gland during the early planar scintigraphy (Figure 1).

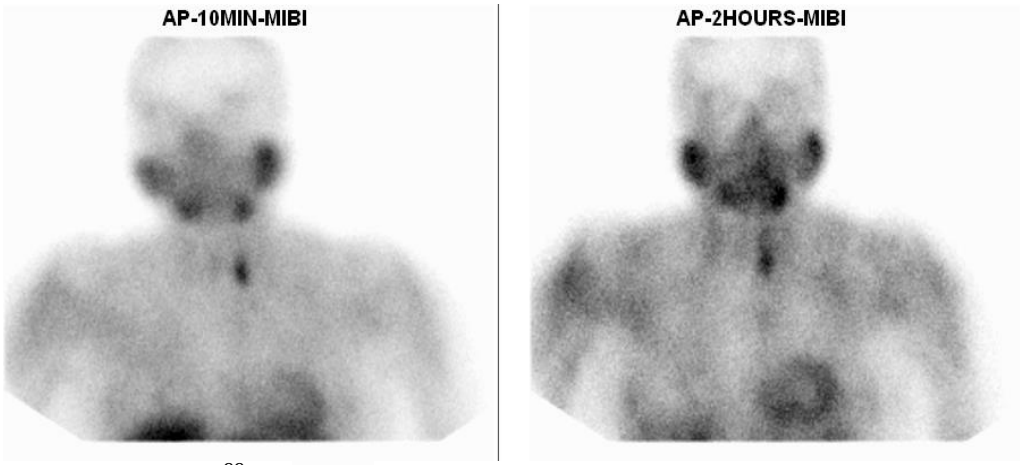

Fig. 1. Images of ^{99m}Tc-MIBI parathyroid scan. a. Early planar image (10 min): Focus of increased activity under the lower pole of the left lobe accompanied by complete absence of the activity from the whole thyroid gland. b. The 2-hour delayed planar image shows a persistent focus of activity in the left neck consistent with an inferior left adenoma.

The uptake in the salivary glands and the heart was normal. ^{99m}Tc-pertechnetate scan revealed thyroid with normal size and position and homogenous uptake of the radiopharmaceutical (Figure 2). The patient took no medications or supplements at the time before and during the scintigraphy.

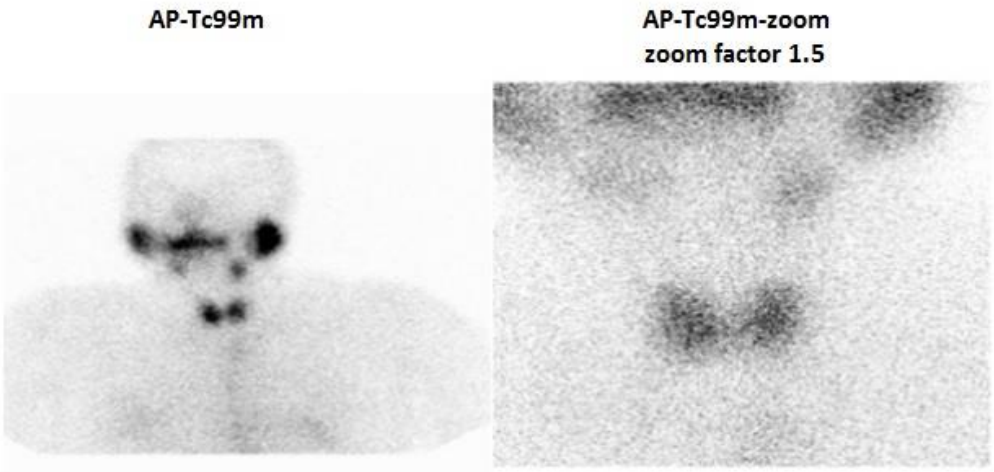

Fig. 2. ^{99m}Tc-pertechnetate thyroid scan revealed normal shaped thyroid with homogeneous tracer uptake.

DISCUSSION

Diminished early thyroid uptake of ^{99m}Tc-MIBI, 10 to 20 minutes after injection during parathyroid or thyroid scintigraphy is a scintigraphic pattern that is insufficiently investigated according to current literature. There are a few studies and case reports that were dedicated to the low ^{99m}Tc-MIBI uptake in the thyroid. Most frequently encountered cause reported in the literature is chronic thyroiditis or amiodarone induced thyrotoxicosis. Santos et al. [6] investigated the ^{99m}Tc-MIBI thyroid uptake in euthyroid individuals and in patients with autoimmune thyroid disease 5 minutes after injection of the tracer. Their study found reduced

^{99m}Tc-MIBI uptake in patients with atrophic Hashimoto's thyroiditis (AHT), while patients with hypertrophic Hashimoto thyroiditis showed no lower ^{99m}Tc-MIBI uptake compared to euthyroid controls. The authors concluded that this kind of findings were probably due to glandular destruction and fibrosis during AHT. The case report of Turkolmez et al. [7] reported a patient with chronic thyroiditis confirmed with fine needle biopsy, ultrasound findings and presence of anti-microsomal and anti-thyroglobulin antibody that presented with absent uptake of ^{99m}Tc-MIBI 20 minutes after injection and absent ^{99m}Tc-pertechnetate uptake as well. Amiodarone-induced thyrotoxicosis type 2 is reported to cause diminished thyroid uptake of ^{99m}Tc-MIBI. Scintigraphy with ^{99m}Tc-MIBI is proposed as a tool for differentiation between type 1 and type 2 amiodarone-induced thyrotoxicosis. Amiodarone-induced thyrotoxicosis type 1 is caused by an iodine overload that causes excessive thyroid hormone synthesis in patients with underlying autonomy or latent Grave's disease, while type 2 is caused by destruction of follicular cells and consecutive thyroid hormone release. The study of Piga et al. [8] showed absent uptake of ^{99m}Tc-MIBI in patients with type 2 thyrotoxicosis, normal to increased uptake in type 1 amiodarone thyrotoxicosis, and patchy, low uptake with fast washout in some patients with undetermined type of amiodarone thyrotoxicosis. Diminished ^{99m}Tc-MIBI thyroid uptake was reported in patients without thyroid disease. The study of Kiratli et al. [9] reported decreased thyroid to mediastinum ^{99m}Tc-MIBI ratio in patients with chronic renal failure with or without calcitriol supplementation. They postulated the possible role of calcitriol in the induction of P-glycoprotein (Pgp). Since Pgp is known energy-dependant transmembrane efflux pump interacting with drugs that are mostly lipophilic and cationic, the decreased ^{99m}Tc-MIBI thyroid uptake in patients treated with calcitriol could be due to the Pgp-mediated efflux of ^{99m}Tc-MIBI (10).

However, other mechanisms can decrease thyroid ^{99m}Tc-MIBI uptake by altering the mitochondrial and plasma membrane potential in patients with chronic renal failure, which was also acknowledged as possible in this study [9]. The absence of ^{99m}Tc-MIBI uptake on early scans during parathyroid scintigraphy without plausible explanation has so far been reported only in the case report of Koca et al. [11]. These authors presented a case of a patient with normal thyroid ultrasonography, thyroid hormones within normal range and normal ^{99m}Tc-pertechnetate scan that showed non visualization of the thyroid during early phase of the ^{99m}Tc-MIBI parathyroid scintigraphy, and very faint uptake during ^{201}Tl scintigraphy. The case is similar to our case report. Our patient did not have any chronic or endocrinological disease in the medical or family history other than increased PTH; had normal thyroid hormones and antibodies within normal range, completely normal thyroid ultrasound and ^{99m}Tc-pertechnetate scan, yet absent thyroid ^{99m}Tc-MIBI uptake. Considering that low ^{99m}Tc-MIBI uptake is reported in patients with destructive processes in the thyroid due to thyroiditis, the absent ^{99m}Tc-MIBI uptake in a patient with normal thyroid and absence of any other disease is rather unusual. There was no possible explanation for this finding in our patient. Although this finding has had no known consequences on the health of the patient, one should be aware of the possibility of this scintigraphic appearance of the thyroid during the interpretation of the parathyroid scintigraphy with ^{99m}Tc-MIBI.

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UDC: 617.736-056.7:575.224.23

CASE REPORT

CLINICAL AND GENETIC CHARACTERISTIC OF AUTOSOMAL DOMINANT STARGARDT-LIKE DISEASE

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ABSTRACT

Objective: Presentation of 7-year-old boy with a Stargardt-like disease using noninvasive imaging techniques and genetic investigation.

Description: A seven-year-old boy was examined at the Department of Retina at the University Eye Clinic in Skopje, by the ophthalmologist after a pediatric systematic examination. From the heteroanamnesis it was established that the child was watching TV close to the monitor. His teacher noticed that he could not see letters and numbers from the back of the classroom. The visual acuity was 0,1 on both eyes without correction and was 0,16 with glasses. The biomicroscopy, ophthalmoscopy, OCT, FFA and ERG was done. Genetic testing was performed as well.

Conclusion: OCT, FFA, ERG help for the clinical stadium diagnostics and monitoring of Stargardt Macular dystrophy or Stargardt-like macular dystrophy. Furthermore, since no effective therapy for treating the Stargardt-like disease is available, understanding the disease progression will be essential in developing and monitoring response to therapies in the future.

Keywords: Stargardt Macular dystrophy, Fundus flavimaculatus, Stargardt like disease, gene ABCA4, gene ELOVL4

INTRODUCTION

The Stargardt macular dystrophy is autosomal recessive inherited macular degeneration, although dominantly inherited cases have been described as well. The Stargardt disease/fundus flavimaculatus is one form of macular dystrophy in childhood, affecting 1 in 10.000 individuals [1]. Stargardt-like disease is autosomal dominant inherited disease and is phenotypically similar to autosomal recessive Stargardt disease. An autosomal dominant form of rare Stargardt dystrophy also known as Stargardt-like dystrophy is caused by mutation in a gene encoding ELOVL4, an enzyme that catalyzes the elongation of very long-chain fatty acids in photoreceptors and other tissues. Characteristic features include significant loss of visual acuity, i.e. central vision. There are bilateral atrophic changes in the central retina-macula associated with degeneration of photoreceptors and underlying retinal pigment epithelial cells. In some cases, presence of yellow flecks extending from the atrophic macula can been seen. Diagnosing is usually during the first or second decade of life with impaired visual acuity. Both sexes are affected equally.

CASE REPORT

From the heteroanamnesis the parents claim that their child watches television sitting close to the monitor. He could not see letters and numbers, from far away. They were aware that something is not normal with the child's vision very early, since he was 5 years old. They have made consultation with the neurologist and MR (magnet resonance) was done. The patient did not complain for impairment night vision. The child was adopted.

The vision of the right eye was 0,1 without correction and vision of the same eye with refraction of +0,50 D sph +0,75 D cyl/90 was 0,16 on the Snellen optotype. The vision of the left eye was 0,1 without correction and vision of the same eye with refraction of +0,50 D sph +0,75 D cyl/110 was 0,16 on the Snellen optotype. The autorefractometry was done and the results were: OD +0,75 D sph +1,0 D cyl /90 and OS +0,50 D sph + 1,0 D cyl /110. The intraocular pressure was digitally normal. Ishihara test for color vision deficiency was done. The patient had mild color vision loss for the red/green colors.

The primary examination was done, including biomicroscopy and ophthalmoscopy. Using the inspection with light, no abnormalities were seen of the lids, super cilium etc. Biomicroscopy investigation of the anterior segment showed normal findings. Optical media were clear. On the posterior segment, the fundus finding on both eyes was: vital papilla optic nerve with clear boundary, blood vessels with normal lumen, pre-grouping of the pigment epithelium resulting in an oval lesion on macula with 1,5 disk diameter in size without reflex on the right eye and with beaten bronze reflex on the left eye (Figure 1).

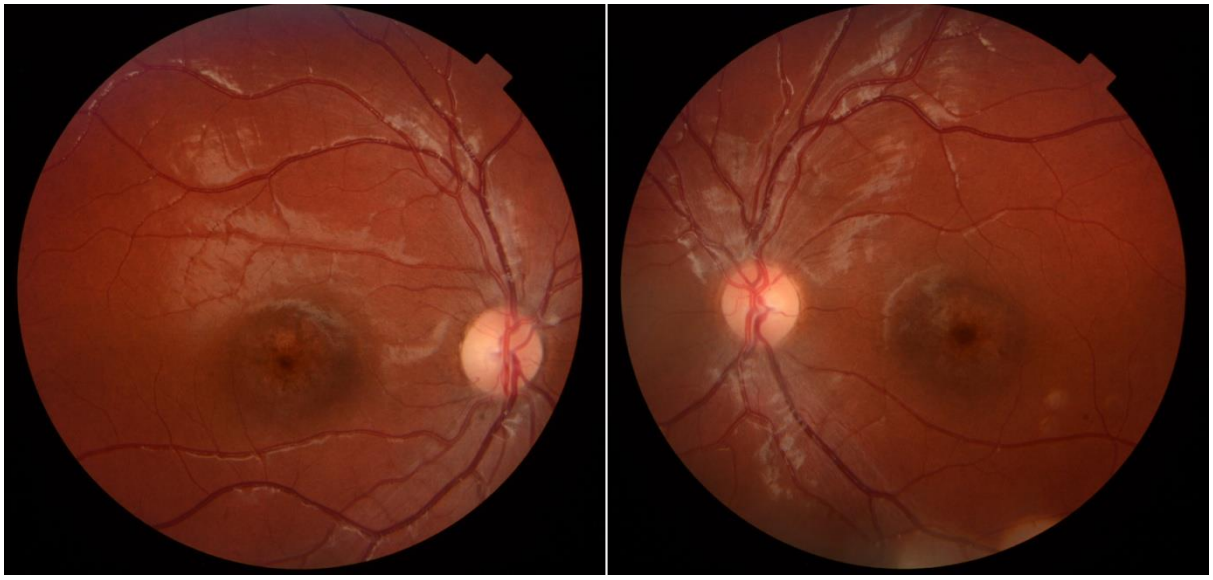

Fig. 1. Red Cam fundus images of Stargardt-like disease (macular pregrupation of pigment-epitelial cells and atrophy of the RPE in ML).

Additional investigations were done, such as optical coherent tomography (OCT) and fluorescein fundus angiography (FFA). OCT images on both eyes revealed disruption, absence or thinning of intraretinal layers. The visual acuity loss correlated with central fovea thickness in atrophic areas in the patient (Figure 2).

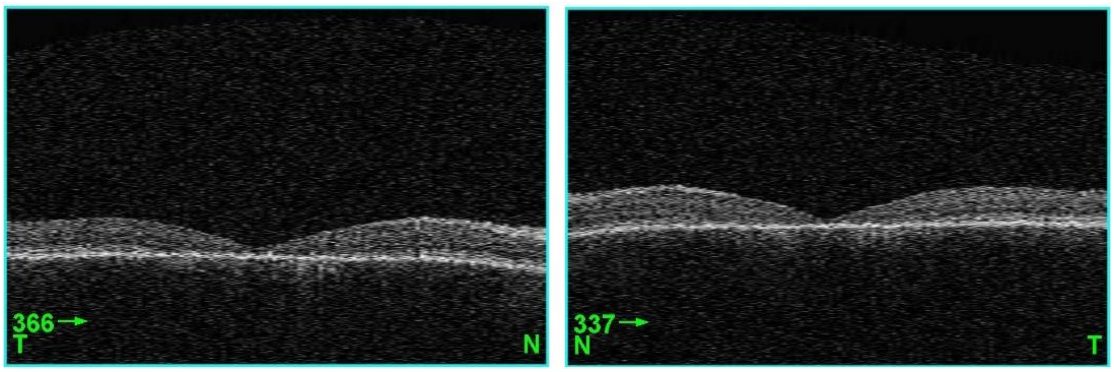

Figure 2. 3D OCT images: disruption of inner and outer photoreceptors' layers and central foveal thickness.

On the angiogram from the fluorescein fundus angiography, the characteristic signs for Stargardt disease were present. During FFA , lipofuscin absorbs blue excitatory light producing the characteristic dark choroid (blockage of choroidal fluorescence). Hyperfluorescence in the macula zone was present because of the atrophic changes in the retinal pigment epithelium (Figure 3, 4).

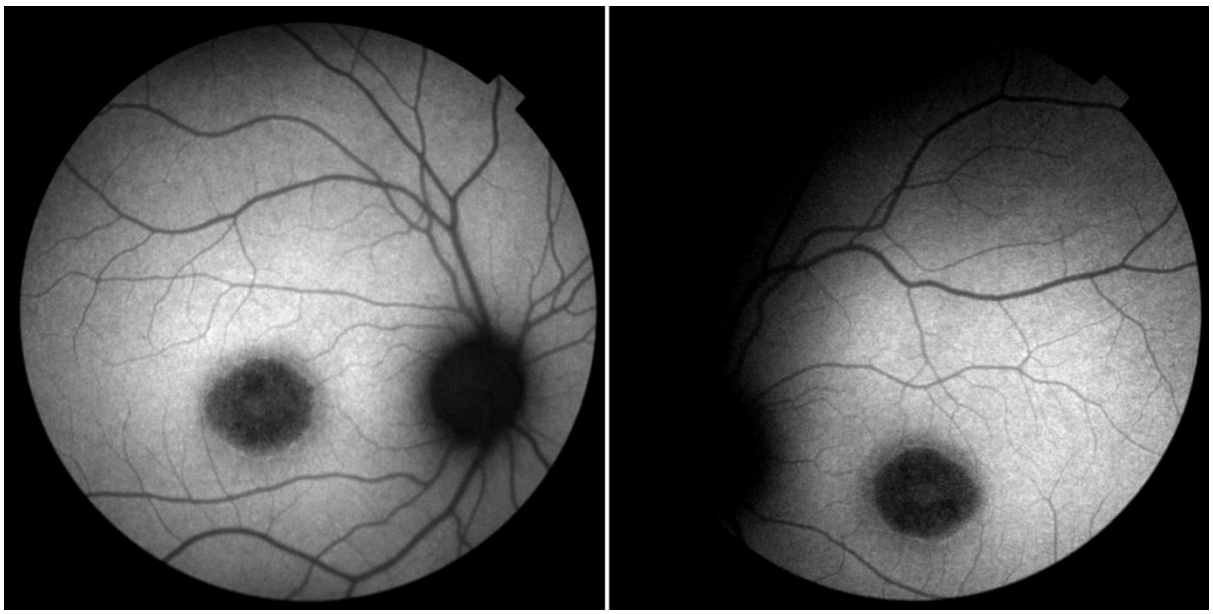

Fig. 3. Fundus autofluorescence images of Stargardt-like disease, dark macular zone with clear boundary.

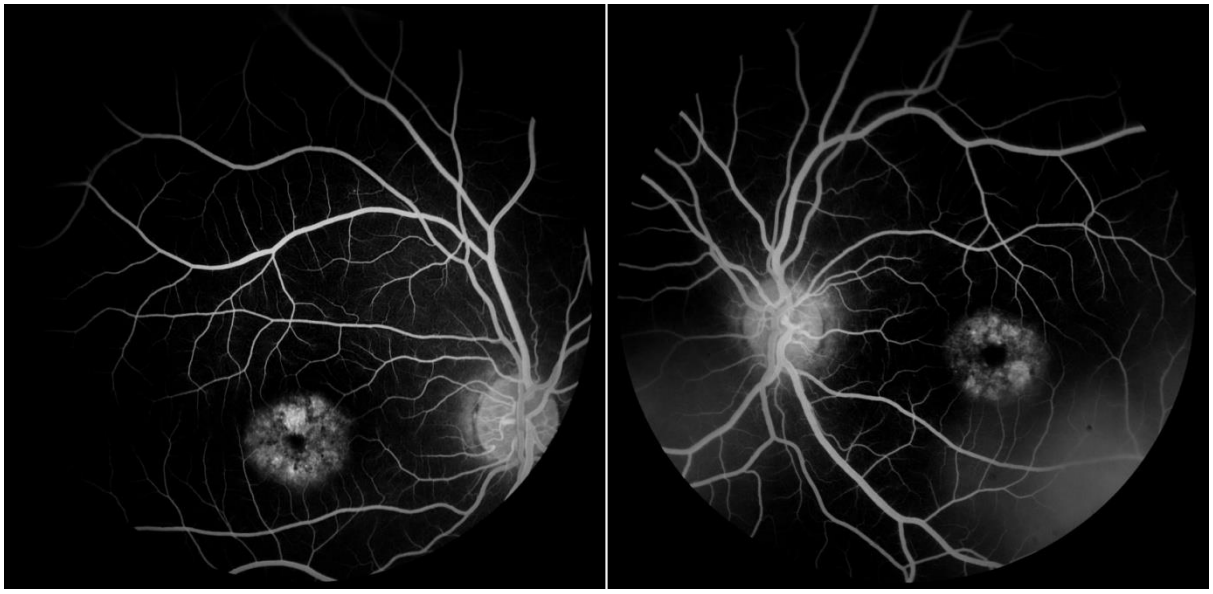

Fig. 4. FFA angiogram: dark choroid and window efect in the macula (hyperfluorescence)

With the aim to complete the clinical diagnosis the patient was sent to the EAD Aleksandrovska University Hospital in Sofia, Bulgaria, for an electroretinography (ERG) exam (Reti scan multifocal ERG) and Kugel perimeter. The results of the ERG were abnormal: right eye OD- to 30,45 miV/43.7 ms.; left eye OS- to 25, 62 mi V/42.7 ms., the bioelectrical activity is reduced by 40% on the right eye and 50% on the left eye, primarily in the zone of 20 degrees (Figure 5). The results of the Kugel perimeter exam were normal peripheral vision field on both eyes.

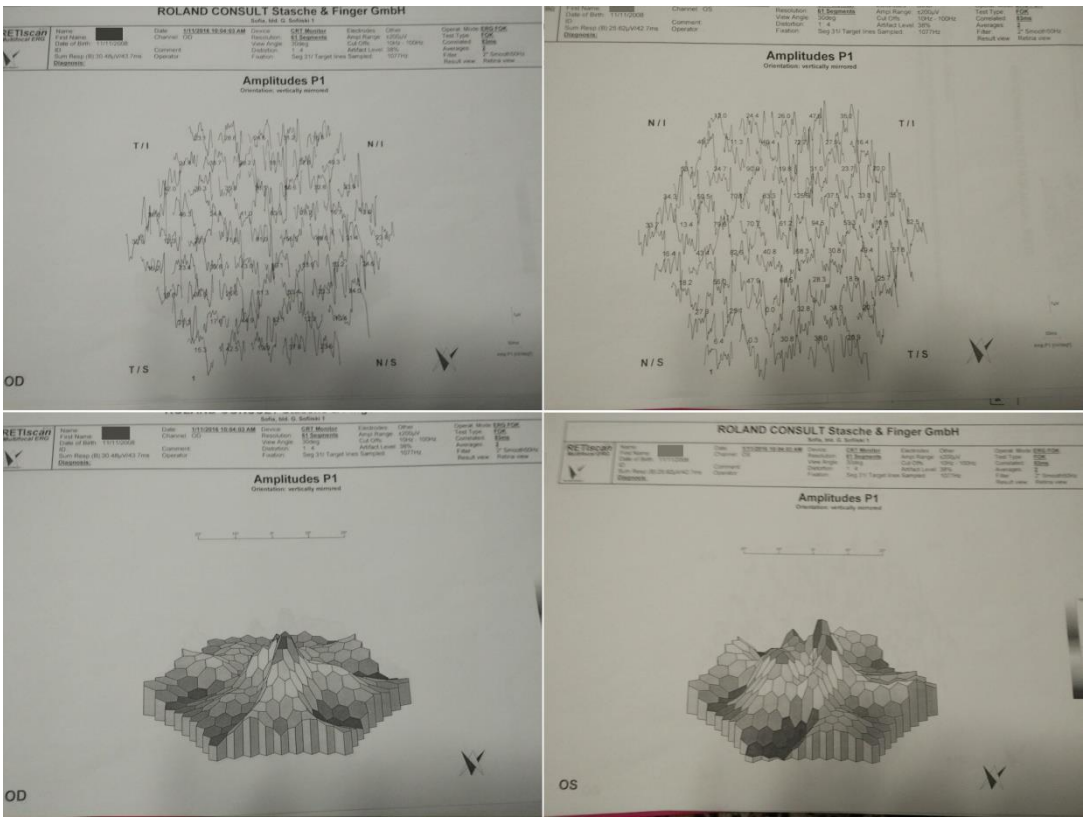

Fig. 5. ERG of Stargardt-like disease reduce bioelectrical activity for 40% OD and 50% OS

Moreover, genetic testing was performed and the STGD3 gene has been mapped to chromosome 6q in this patient with genetically distinct autosomal dominant form of Stargardt-like disease. The genetic testing proves the clinical diagnosis.

After one year, on the control examination the vision acuity was unchanged. Vision acuity of the right eye was of 0,1 without glasses and of left eye was 0,1 without glasses on the Snellen optotype.

DISCUSSION

The first description of the disease was by Karl Stargardt in 1909 and the gene discovery was by Allikments and colleagues in 1997.

As the name implies, autosomal dominant Stargardt-like disease is phenotypically similar to autosomal recessive SD [2, 3, 4, 5]. The STRGD3 gene was first identified in 2001 by Zhang and coworkers and shown to encode ELOVL4 (elongation of very long chain fatty acid-4), a member of the ELO family of proteins involved in the elongation of fatty acids [6].

Fundus flavimaculatus (FF) is a retinal disease first described by Franceschetti in the 1960s [7]. It is characterized by the symmetrical appearance of yellow-white flecks extending from the macula [7, 8]. Extensive clinical and genetic analyses have shown that autosomal recessive SD and FF are variations of the same disease, typically caused by different mutations in the same gene [9, 10, 11]. Fundus flavimaculatus is generally used to describe a late onset and milder form of SD [12, 13].

Two genes associated with inherited macular degeneration disease encode proteins that function in the processing of lipids in photoreceptor cells. Mutations in the gene known as ABCA4 cause autosomal recessive SD and related macular disease [14]. Mutations in the gene encoding ELOVL4, an elongate enzyme involved in the elongation of very long chain fatty acids, have been linked to autosomal dominant SD-like disease [6].

The gene ABCA4 encodes the rod and cone photoreceptor Rim protein, which is a transmembrane transporter of vitamin A intermediates. This gene produces a protein that binds the toxic by-products of vitamin A in the photoreceptors, preventing Vit A toxicity to the photoreceptors esp. the cones. Therefore, the ophthalmologists have to avoid prescribing any Vitamin A, especially high doses.

FFA shows impairment or blockage of choroidal fluorescence and dark choroid characterized by absence of normal background fluorescence, because lipofuscin absorbs blue excitatory light producing the characteristic dark choroid appearance in many Stargardt disease (SD) patients [15]. The hyperfluorescence in the macula zone is present in the patients with SD because of the atrophic changes in the retinal pigment epithelium (RPE). FFA is diagnostic key method for the SD disease. On the angiogram, the macular window defects (hyperfluorescence) are coupled with characteristic dark choroid. The diffuse darkening is due to background blocking of choroidal fluorescence, by the widespread deposits of toxic material in the RPE. Histochemical analysis of donor eyes from deceased SD patients revealed significant loss in photoreceptor cells and excessive accumulation of lipofuscin deposits in the RPE cells [8, 16].

Electroretinography (ERG) and electrooculography (EOG) are usually abnormal only in advanced cases when the changes have progressed to involve the RPE, choroid and neurosensory retina diffusely. Scotopic electroretinograms characterizes with rod photoreceptor function and photopic ERGs that measure cone response differ between Stargardt patients. Some individuals show relatively normal full-field ERGs, whereas some patients exhibit significant loss in scotopic and/or photopic ERGs [17, 18, 19]. The ERG provides clinically important information of retinal function for SD patients, hence the ERG is

primarily used for diagnostics and monitoring of the evolution of the SD in these patients. EOG is not widely used, however it is useful if there is abnormal Arden's ratio.

Gene therapy for SD associated with ABCA4 Gene-mutations in the photoreceptor-specific flippases lead to accumulation of the toxic bisretinoid A2E, resulting in atrophy of the retinal pigment epithelium (RPE) and death of the photoreceptor cells. Many blinding diseases are associated with this type of mutations including the Stargardt disease, con rod dystrophy, retinitis pigmentosa and increased susceptibility to age related macular degeneration. The future therapy approaches to ABCA4 gene therapy may include the treatment with novel AAV vectors, lentiviral vectors and non-viral compacted DNA nanoparticles. As a result of the development of these novel technologies, effective therapies for ABCA4 associated diseases may finally be within reach [20].

Since there is no effective treatment for SD patients, the disease progresses over time and the visual acuity worsens. Once the patient's visual acuity drops below 6/12, it tends to decrease rapidly and stabilize at about 6/60 to 3/60. SD-affected individuals typically experience significant loss in central vision with a marked reduction in visual acuity in their first or second decade of life [21, 22]. Progressive reduction in visual acuity generally occurs through the patient's life with values reaching 20/200 or worse in the final stages of the disease. SD patients show a delay in dark adaptation and variable loss in color vision as well [12, 23, 24, 25]. In general, peripheral visual fields and night vision are normal in SD patients. The degree and type of color vision deficiency in Stargardt disease patients correlate better with best visual acuity than with ERG results. The presence of specific color vision deficiencies may help to establish a diagnosis of SD [26].

The Stargardt disease (macular dystrophy) or Stargardt-like disease (macular dystrophy) have similar clinical appearance. For both diseases the early diagnosis is important, because the genetic counseling has to be done subsequently for children and family. It is important to redirect children to studies less dependent on reading. The usual age of diagnosis is in the first or more often second decade, between 18-20 years, when the young patient is already in college and finds himself/herself unable to proceed and finish the studies.

CONCLUSION

Early diagnosis of SD like disease or SD is important for the correct redirecting of the patients to suitable studies. If the child or teenager complains of poor vision, the ophthalmologist has to think about SD and should not conclude prematurely that the reason of poor vision acuity is bilateral amblyopia or hysterical visual loss. OCT, FFA, ERG help for the clinical stadium diagnostics and monitoring of Stargardt Macular dystrophy or Stargardt-like macular dystrophy.

Furthermore, since no effective therapy for treating the Stargardt-like disease is available, understanding the disease progression will be essential in developing and monitoring response to therapies in the future. As a result of the novel genetic technologies, effective therapies for ABCA4 associated diseases may finally be within reach.

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UDC: 616.727.2-072.1

REVIEW ARTICLE

ANATOMY AND CLASSIFICATION OF THE LABRO-CAPSULAR AND TENDON INJURIES OF THE SHOULDER

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ABSTRACT

Shoulder arthroscopy has revolutionized the understanding of shoulder anatomy and pathology. It is of great importance for the arthroscopic surgeon to have a clear understanding of the anatomy of the shoulder. The main goal of this review article is to discuss the shoulder anatomy relevant for the classification of the soft tissue injuries. The following structures anatomy is discussed, as well as some of the classifications for their lesions: pulley lesions; the long head of biceps pathology including the SLAP (superior labral tear anterior to posterior) lesions; glenohumeral ligaments; types of the lesions in the anterior shoulder instability, as well as Hill-Sachs lesions.

Key to promote healing in the shoulder is to understand anatomy. Having a thorough understanding of basic shoulder anatomy is essential in developing good shoulder arthroscopic technique. The shoulder arthroscopy is minimally invasive surgery and fast, reliable and safe procedure.

Key words: Shoulder anatomy, Shoulder arthroscopy, Bankart, SLAP, Glenohumeral ligaments

INTRODUCTION

Shoulder arthroscopy has revolutionized the understanding of shoulder anatomy and pathology. As trauma surgeons we are experienced to solve arthroscopically many shoulder pathologies that in the past decades had no answers.

First, the anatomical structures are under no moral obligation to be where we think they should be; they are where they are. And second, preparation is the only shortcut we surgeons would ever need. We use these two famous sayings, the first one emphasizes the importance of good knowledge of normal anatomy and anatomical variances, and the second one emphasizes the importance of planning the surgical procedure. Key to promote healing in the shoulder is to understand anatomy.

As we know the shoulder has inherent instability. There is a discrepancy between the humeral head and the glenoid. Therefore the surrounding soft tissue is of great importance for the shoulder stability.

As Maurice E. Müller stressed "a classification is useful only if it considers the severity of the bone lesion and serves as a basis for treatment and for evaluation of the results". Good communication is essential for injury evaluation, treatment and reporting. We have to speak the same language to understand ourselves [1].

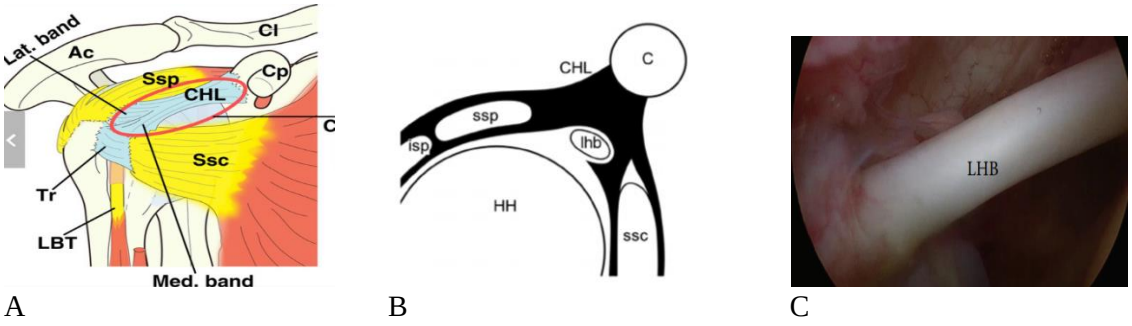
Before introducing the arthroscope in the shoulder joint and proceeding to a formal joint evaluation, it is important for the surgeon to have a clear understanding of the anatomy of the shoulder. The main goal of this article is to discuss the shoulder anatomy relevant for the classification of the soft tissue injuries.

PULLEY LESIONS

The pulley is located where the biceps curves 30-45^0 into the extra-articular groove. The subscapularis tendon extends over the pulley to the greater tuberosity. Accessory head of the long head of the biceps tendon (LHBT) prevalence is 9-22% [2].

LHBT function is as stabilizer of the glenohumeral joint (GHJ) to resist posterior translation of the shoulder in combined shoulder abduction and external rotation (ABER). The long head of the biceps (LHB) is also a humeral depressor and it is fixed between glenoid and the humerus, moving with 4 cm excursions from flexion to extension.

Conceptually, the biceps pulley mechanism is composed of fibers of the superior glenohumeral (SGHL) and coracohumeral ligaments (CHL) with contributions of the subscapularis and supraspinatus tendons. This complex attaches at the lesser and greater tuberosity forming a sling around the LHBT as it enters the bicipital groove and acts as a pulley to buttress the LHBT medially, as it undergoes a bend to enter the bicipital groove. The primary medial stabilizers are the medial limbs of the superior glenohumeral and coracohumeral ligaments and the subscapularis tendon. Recent anatomic and histologic studies emphasize the importance of the superior insertion of the subscapularis tendon in preventing medial LHBT instability [3].



A B C

Fig.1. A, B. Schematic view [4]. Functional anatomy of coracohumeral ligament (CHL) (black area) extends laterally from the base of coracoid (horizontal limb). The anterior CHL likely holds the subscapularis muscle (ssc). The posterior CHL enveloping the supraspinatus (ssp) and infraspinatus (isp). Both anterior and posterior CHL anchors the muscles to the coracoid process (C).

The origin of coracohumeral ligament (CHL) is the anterior coracoid process, it inserts on the greater and lesser tuberosities, and blends with the capsule in the rotator interval. The ligament histologically is composed of irregular and sparse fibers and contains relatively rich type III collagen, which would suggest flexibility [4]. Anatomic knowledge of the CHL in recent studies suggested that the CHL envelops vaster areas than it had been expected. Macroscopically, the CHL was divided into 2 parts: one part spreads fibres over the rotator interval to the posterior portion of the greater tuberosity and the other part envelops the superior portion of the subscapularis, supraspinatus, and infraspinatus tendons. The anterior CHL holds the subscapularis muscle and anchors the muscle to the coracoid process in a similar manner to that of the posterior CHL enveloping the supraspinatus and infraspinatus [4]. Both, anterior and posterior limbs of CHL anchor the muscles to the coracoid process, as shown in Figure 1.

LHBT injuries occur with repetitive load and abrasive wear, contrary of less commonly acute trauma. Most biceps tendon abnormalities are accompanied by other internal derangements like SLAP (Superior labral tear from anterior to posterior lesion) and RCT (rotator cuff tear) especially in overhead sports, as well as aging [5]. Lesions of the biceps pulley and the rotator cuff have been reported to be associated with an internal antero-superior impingement (ASI) of the shoulder [4, 5].

A more recent modification of the Habermeyer system incorporates 6 patterns of tendon instability which can be grouped into the categories of tendon displacement or subluxation, extra-articular dislocation, and intra-articular dislocation. This classification of biceps instability provides valuable information regarding pathogenesis [6, 7]. It is presented in the Figures 2-8[8].

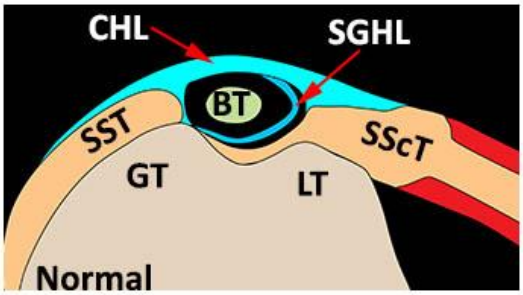


Fig. 2. Normal: Graphic depicting the biceps pulley region from an oblique axial perspective, perpendicular to the course of the LHBT just superior and medial to the bicipital groove. The coracohumeral ligament (CHL) is the most superficial layer of the biceps pulley mechanism and extends over the subscapularis (SScT) and supraspinatus (SST) tendons. The superior glenohumeral ligament fuses with the CHL laterally and forms a ligament layer between the biceps tendon (BT) and the superior-most inserting subscapularis tendon (SScT) at the lesser tuberosity (LT).

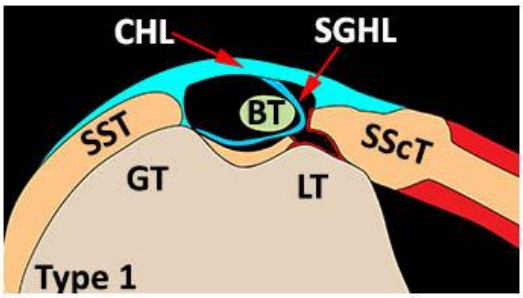


Fig. 3. Type I: Tendon displacement-subscapularis tendon (SScT) tear alone. Medial shift or minor subluxation of the biceps tendon secondary to a partial intra-substance or anterior tear of the subscapularis tendon with intact medial ligament component of the biceps pulley.

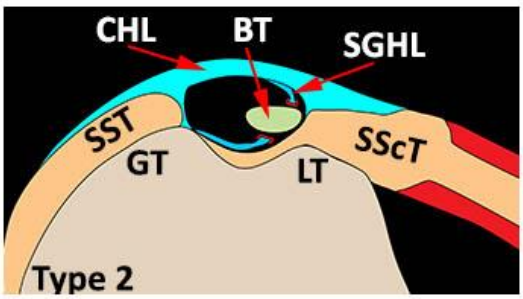


Fig. 4. Type II: Tendon displacement-medial ligament tears alone. Slightly greater medial subluxation of the biceps tendon through the torn portion of the ligaments, but the intact subscapularis tendon fibers prevent medial dislocation.

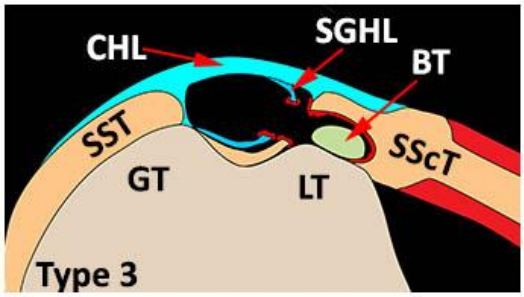


Fig. 5. Type III: Extra-articular tendon dislocation-tears of the medial ligaments and subscapularis tendon. A partial intra-substance tear of the subscapularis tendon allows the biceps tendon to dislocate medially without entering the joint because of intact deep fibers of the subscapularis tendon.

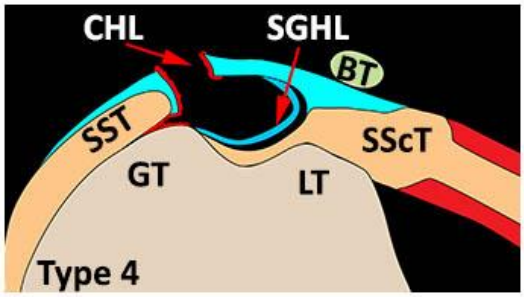


Fig. 6. Type IV: Extra-articular tendon dislocation-tears of the lateral limbs of the ligaments with an intact subscapularis tendon. The biceps tendon dislocates anteriorly becoming located anterior to the intact subscapularis tendon. This pattern has a high association with partial or full-thickness tears of the supraspinatus tendon.

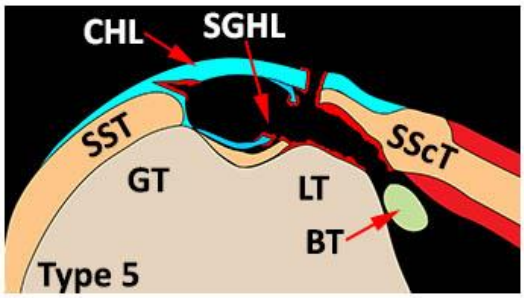


Fig. 7. Type V: Intra-articular tendon dislocation - tears of the medial and lateral limbs of the coracohumeral and superior glenohumeral ligaments with a full-thickness tear of the subscapularis allows medial dislocation of the LHBT into the joint.

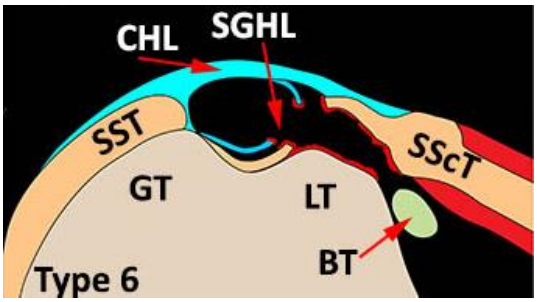


Fig. 8. Type VI: Intra-articular tendon dislocation-tear of the medial limbs of the ligaments and detachment of the subscapularis from the lesser tuberosity.

SLAP

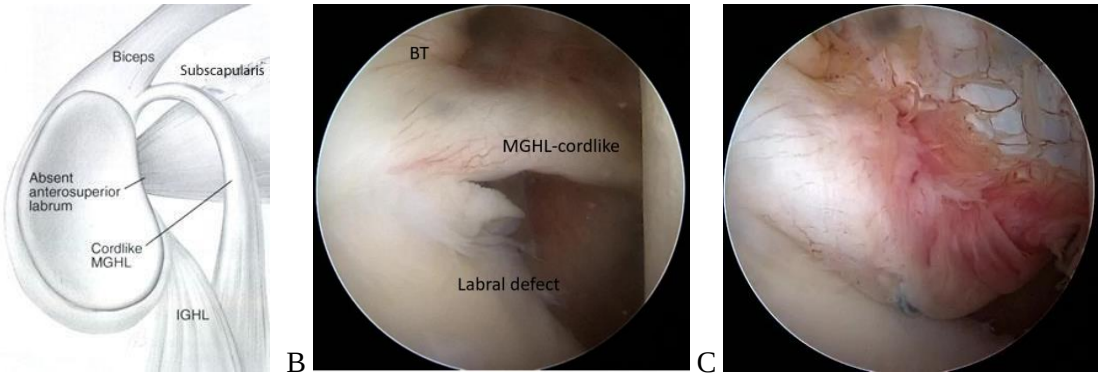
Long head of biceps tendon (LHBT) originates from the supraglenoid tubercule and superior labrum. Glenoid origin is variable between individuals in range of anterior and posterior origin.

SLAP is defined as injury of Superior Labral tear from Anterior to Posterior in relation to biceps tendon anchor and is usually accompanied by symptoms of pain, clicking and/or instability. SLAP tears occur from several mechanisms. One mechanism involves forceful eccentric traction exerted on the biceps tendon. This can occur when someone falls back onto an outstretched arm, tries to prevent him or herself from falling by grabbing hold of an object, or suddenly tries to lift a heavy object. Many SLAP lesions occur in throwing or overhead athletes. When throwing a ball or other object, or performing similar motions (eg, swinging a hammer), the shoulder is forcefully abducted and externally rotated during the cocking phase. This motion performed while the hand carries a weight places stress on the labrum. Shear forces created by the movement of the humeral head anteriorly and superiorly must be resisted by the anterior joint capsule, which inserts partially into the superior anterior labrum. These forces can produce labral tears. While the true overall incidence of SLAP tears is unknown, the incidence among patients undergoing arthroscopy is reported to be between 6 - 26 % [9, 10, 11]

There are 3 types of attachment of the superior labrum at the 12 o'clock position where biceps tendon inserts (figure 9). This sublabral recess sometimes can be difficult to distinguish from a SLAP tear or sublabral foramen (Figure 9).

Fig. 9. Types of the superior labrum attachment

Are this normal labral variants really normal? The answer is no according Russel Fritz [12]. These labral variants are probably all acquired lesions that result in measurable microinstability and shoulder dysfunction. Evidence for this is that labral variants are not present at birth. Labral variants become more common with age. **Buford complex** is a congenital glenoid labrum variant where the anterosuperior labrum is absent in the 1-3 o'clock position and the middle glenohumeral ligament is thickened (cord-like) and originates directly from the superior labrum at the base of the biceps tendon and crosses the subscapularis tendon to insert on the humerus (Figure 10). Buford complex is present approximately in 1,5% of the cases [13] and it is not described in fetal specimens, it may be acquired and is associated with SLAP lesions. It is important to notice that greater degrees of labral detachments result in greater degrees of labral dysfunction.



A B C

Fig.10. Buford complex. A. Schematic view. B and C. Arthroscopic view (our case): before and after arthroscopic reconstruction (MGHL Middle glenohumeral ligament, BT Biceps tendon).

GLENOHUMERAL LIGAMENTS (Figure 11) [14]:

Superior glenohumeral ligament (SGHL)

This structure is found to be present in 40-94% of shoulders and, when present, tends to have the most consistent anatomy of the three anterior ligaments. It arises from the 12 o'clock position at the supra glenoid tubercle but can also take origin from the biceps anchor and labrum. It travels parallel to the biceps tendon to insert on the medial edge of the bicipital groove and the fovea capitus (just superior to the lesser tuberosity). Laterally, at its insertion, the SGHL joins the coracohumeral ligament, contributes to the biceps pulley and forms part of the rotator interval. The lateral insertion of the SGHL means that this structure plays a crucial role in the stabilisation of the biceps tendon against anterior shearing stress as part of the pulley system.

Middle glenohumeral ligament (MGHL)

This ligament is present in 84-92% of shoulders and arises variably from the upper part of the glenoid, the labrum, or with the SGHL. It then runs diagonally downward and across the subscapularis tendon at 45° to insert into the inferior part of the lesser tuberosity.

Inferior glenohumeral ligament (IGHL)

The IGHL has an anterior band (IGHLa) which takes origin from the glenoid between the 2 and 5 o'clock positions and a posterior band (IGHLp) which takes origin from the 7-9 o'clock position. These converge to form a sling which inserts onto the humerus in the 4-8 o'clock position. This anatomical arrangement dictates that the IGHL acts as the main static stabiliser of the GHJ in abduction. We have to keep in mind that the distance from the inferior glenoid to the axillary nerve is 12,4 mm. It lies posterior to the axillary artery and lies to the top of the subscapularis muscle and passes underneath the glenohumeral capsule.

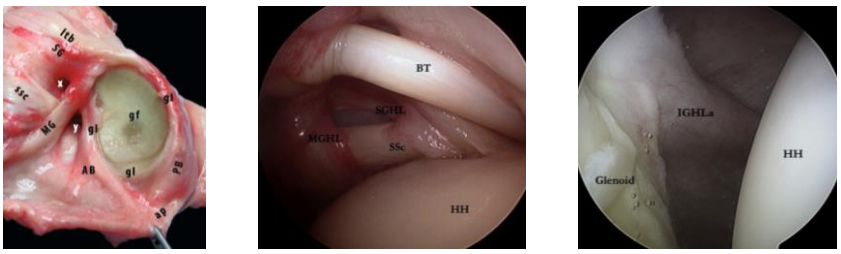


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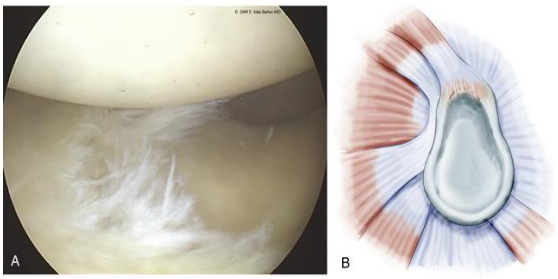
Fig. 11. Glenohumeral ligaments. A. Cadaveric view [14], B.C. Arthroscopic view [15]. ltb (Tendon of th long head of the biceps), SG/SGHL (superior glenohumeral ligament), MG/MGHL (middle glenohumeral ligament), AB/IGHLa (anterior band inferior glenohumeral ligament),PB (posterior band glenohumeral ligament), gf (fossa glenoidalis), gl (labrum), BT (biceps tendon), SSc (subscapularis), HH (humeral head).

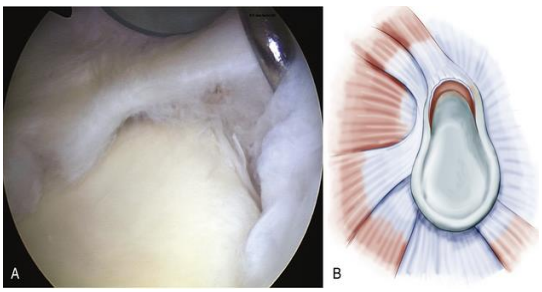
SLAP lesions are an important cause of shoulder pain and instability. Snyder et al. classified SLAP lesions into four main types on the basis of arthroscopic evaluation [16, 17, 18]. The first revised classification of SLAP lesion was reported by Maffet et al. in 1995. Three new category of lesions are added as Type V, VI and VII [19]. With the work of Morgan et al. in 1998 the first variation related to type II SLAP lesion was introduced. A type II A abnormality represents an anterosuperior labral lesion, type IIB posterosuperior lesion and type IIC both anterior and posterior components [20]. Between 1997-2000 year three additional types of SLAP lesion were introduced in meetings and conferences: Type VIII, IX and X according Beltran (Figure 12). Although they are many types of SLAP lesion this represents an attempt to emphasize associated abnormalities that may prove important for treatment algorithm.

Table 1. Type and clock face location of the SLAP lesion

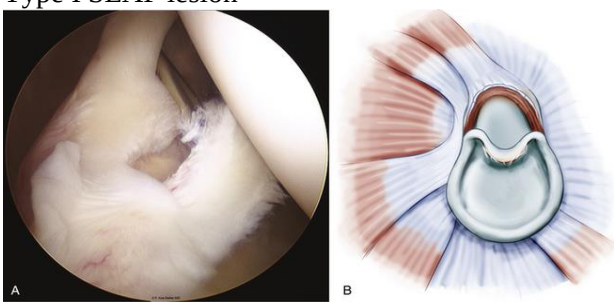
Type	Clock face	Description
I	11 to 1	Fraying of superior labrum
II	11 to 1	Detachment of biceps anchor
III	1 to 1	Bucket handle tear with intact biceps
IV	11 to1	Bucket handle tear with biceps extension
V	11 to 5	Type II + Bankart lesion
VI	11 to 1	Type II +Flap tear of bucket handle
VII	11 to 3	Type II + extension into MGHL(injury)
VIII	11 to 7	Type II + posterior extension
IX	11 to 11	Circumferential (pan-labral) lesion
X	11 to 1	Type II + reverse Bankart lesion (post-inf)



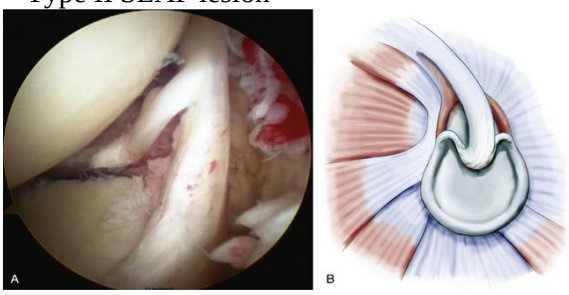
Type I SLAP lesion



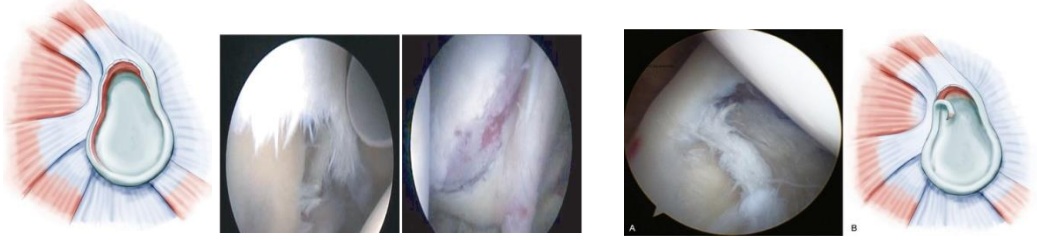
Type II SLAP lesion



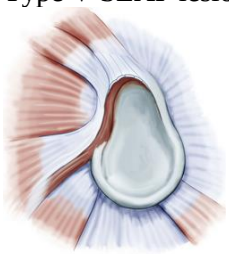
Type III SLAP lesion



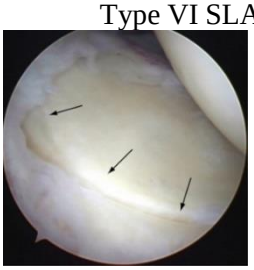
Type IV SLAP lesion



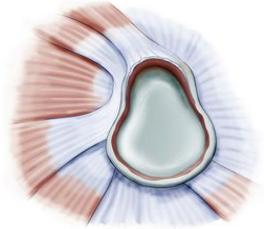
Type V SLAP lesion



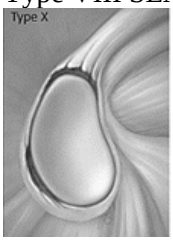
Type VI SLAP lesion



Type VII SLAP



Type VIII SLAP



Type IX SLAP

Type X SLAP lesion

Fig. 12. SLAP lesion, Synder classification (I-IV), Maffet modified (V, VI, VII), other authors (VIII, IX et X).

The glenoid labrum is a fibrocartilaginous structure that attaches to the glenoid rim and is about 4 mm wide. The labrum may show considerable variation in shape (triangular, bumper, meniscal) and it is usually rounded or triangular on cross sectional images. It is important to recognise these variants because they can mimic a SLAP tear.

Avulsion fractures of the anterior glenoid rim, so called bony Bankart lesions, are associated with anteroinferior glenohumeral instability. These fractures typically occur when the glenohumeral joint dislocates. The incidence ranges from 4% to 70% in the literature, with an increased prevalence in male patients. Because these fractures can easily be missed on plain radiographs, computed tomography scans are an important means for correct diagnosis and estimation of the size of the fragment [21].

Very interesting and practical approach for anterior shoulder instability is Matsen's classification. He noted that patients who have recurrent glenohumeral instability can be classified into one of the two groups [22]. The first group is the one that sustained trauma initiating a problem of unidirectional shoulder instability. The shoulders of these patients usually are found to have a rupture of glenohumeral ligaments at the glenoid attachment (Bankart lesion). These patients usually need surgery to achieve stability (TUBS - Trauma, Unidirectional, Bankart and Surgery. The second (large) group of patients has no history of trauma – thus they have atraumatic instability. They are much more prone to have multidirectional instability that is bilateral (laxity). Rehabilitation especially strengthening of the rotator cuff is the first line of treatment (AMBRII - Atraumatic, Multidirectional, Bilateral laxity, Rehabilitation, and Inferior capsular shift procedure). If operation is necessary a global capsulorraphy is performed, which tightens the Inferior capsule and also the rotator Interval (RI).

ANTERIOR SHOULDER INSTABILITY

Some of the types of the lesions in the anterior shoulder instability are (Figure 13):

- PERTHES: A Perthes lesion is a labroligamentous avulsion like Bankart, but with a medially stripped intact periosteum.

- ALPSA: An ALPSA lesion is an anterior labral perioseal sleeve avulsion. The anterior labrum is absent in the glenoid and medially displaced. POLPSA it is reverse ALPSA.

- GLAD: A GLAD lesion is a glenolabral articular disruption. It represents a partial tear of the anteroinferior labrum with adjacent cartilage damage.
- HAGL: A HAGL is a humeral avulsion of the inferior glenohumeral ligament (IGHL)

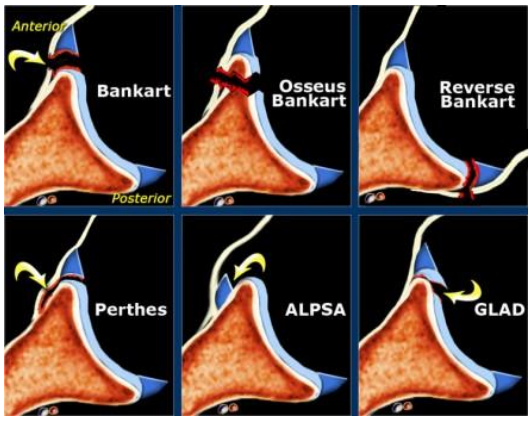


Fig. 13. Types of the lesions in the anterior shoulder instability

HILL-SACHS LESION

For the purpose of evaluating the size of the Hill-Sachs lesion together with the size of the glenoid, a new concept was introduced: the glenoid track. The glenoid track is a contact zone of the glenoid on the humeral head with the arm at the end range of motion, e.g., in various degrees of elevation with the arm in maximum external rotation and maximum horizontal [23].

Itoi and associates introduced the concept of the glenoid track. Using 3-dimensional (3D) computed tomography (CT) scans they identified bipolar bone losses. This concept is completely consistent with concept of the engaging versus non-engaging Hill-Sachs lesion by Burkhart and De Beer [24]. Figures 14 A and B shows the concept of Di Giacomo for "on-track" and "off-track" lesions and table 2 presents the categories of the anterior instability as proposed by Di Giacomo [25].

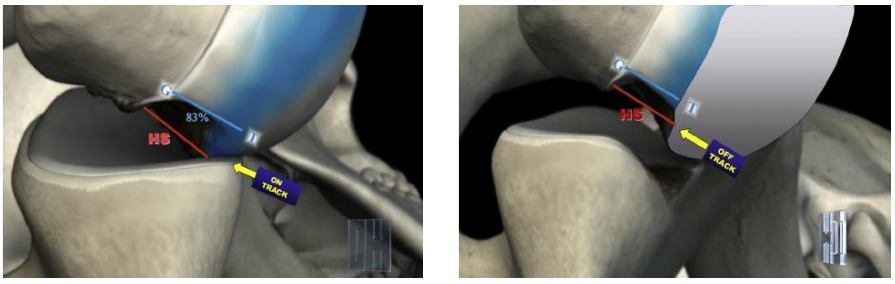


Fig.14. A. "On-track" Hill-Sachs lesion. Glenohumeral joint in maximum abduction and external rotation. G-footprint of posterior rotator cuff. T -medial margin of glenoid truck (GT) contact area between glenoid and humeral head. GT account 83% of glenoid area.B. "Off-track"Hill-Sachs lesion. The Hill-Sachs lesion (HS) extends medial to the medial margin of the glenoid track (G-T), with loss of bone support at the anterior glenoid rim [25].

Methods for arthroscopic quantification of Hill-Sachs lesion are shown of figure 15A,B,C [26].

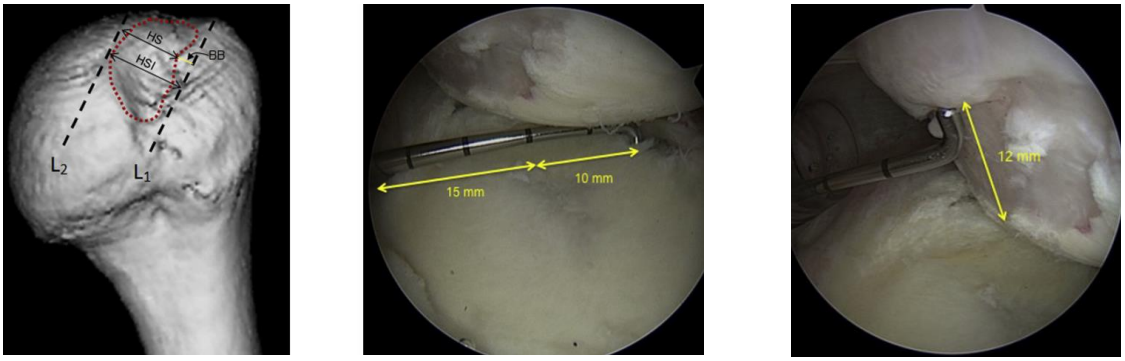


Fig.15. A. HSI= HS Hill-Sachs lesion plus BB (bone bridge, intact bone that lies between HS and posterior footprint. B. Radius of the bare spot of glenoid and posterior glenoid rim-15mm. Distance from the bare spot to the anterior glenoid rim-10mm. C. The width of Hill-Sachs lesion (3x4mm probe) [25].

Table 2. Anterior instability categories by Giovani Di Giacomo

Group	Glenoid defect	Hill-Sachs lesion
1	<25%	On track
2	>25%	Off track
3	≥25%	On track
4	≥25%	Of track

With the foregoing principles the treatment algorithm for every group will consider recommended treatment for the group 1: Arthroscopic Bankart repair; Group 2: Arthroscopic Bankart repair plus remplissage; for Group 3: Latarjet procedure; and for Group 4: Latarjet procedure with or without humeral-sided procedure (humeral bone graft or remplissage). The conversion of an off-track Hill-Sachs lesion to an on-track Hill-Sachs lesion is essential in stabilizing the shoulder with anterior instability [24, 25].

CONCLUSION

Arthroscopy increases as the modality of choice for interventional procedures in shoulder pathology. Shoulder labro-capsular and tendon lesions are an important cause of shoulder pain and instability. Key to promote healing in the shoulder is to understand anatomy. Having a thorough understanding of basic shoulder anatomy is essential in developing good shoulder arthroscopic technique. The shoulder arthroscopy is minimally invasive surgery and FARES (fast, reliable and safe) procedure. The ideal classification system, once validated, should not only describe and categorize tear patterns, but it should eventually be used to predict the type of surgery necessary to repair the tear and give a direction for the eventual outcome of the surgical procedure.

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E e	E e	T t	T t
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Z z	Z z	U u	U u
Y y	Dz dz	F f	F f
I i	I I	H h	Kh kh
J j	J j	C c	Ts ts
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