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USE OF CORROSION CASTS OF RENAL VASCULATURE FOR UG TEACHING

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Abstract

Introduction: The internal three-dimensional structure of organs and patterns of blood vessels is complex and it is often difficult for medical students to visualize and interpret them. The corrosion cast technique is used to study the vascular patterns in kidney as it is one of the powerful tools with anatomical accuracy and durability.

Aim: Preparation of corrosion casts of kidney using CAB (cellulose acetyl butyrate) granules for greater understanding of the spatial relationship of renal vasculature

Objectives

- To accelerate knowledge acquisition
- To determine student's perception to the utility of corrosion casts of kidney in UG teaching

Methodology: Corrosion cast technique involves injection of the cast material (CAB granules) dissolved in acetone into the renal vessels. Gradually, the volatile solvent evaporates and the solute solidifies inside the vessel forming solid permanent cast. The unwanted tissues are then washed away using corrosive agents like conc HCl resulting in three-dimensional representation of blood vessels.

The UG students were divided in 2 groups randomly having 50 students each. Half of the total participants received teaching lessons through a lecture discussing renal blood supply using corrosion casts while the rest with 2D images. The other aspects of teaching session, including content, teaching slides were kept identical in both batches. Crossing over was done.

Results & Conclusion: Post session questionnaires were applied to assess knowledge acquisition and learner satisfaction. Feedback was taken of student's perception on the utility of corrosion casts as an effective teaching – learning method. Analysis of feedback was done. Corrosion casts enhance the student's skills in spatial visualisation of complex vascular relationships. This can be used for other topics as well.

Keywords: corrosion casts, kidney, feedback

Introduction

The internal three-dimensional structure of organs and patterns of blood vessels is complex and it is often difficult for medical students to visualize and interpret these.

Undergraduate medical students studying human gross anatomy often have difficulty conceptualizing the internal three-dimensional structure of organs and the pattern of distribution of blood vessels. Renal vasculature, placental circulation, ventricles of brain is few examples where medical students find it difficult to understand and visualize using two-dimensional illustrations, dissections and videos. Also, the knowledge of distribution of blood vessels is of great importance in resections and transplantation surgeries. Keeping in view, the academic as well as the applied importance of the subject, the present work was undertaken to study vascular pattern in kidney specimens.

The corrosion cast technique was used to study the vascular patterns in kidney as it is one of the powerful tools with anatomical accuracy and durability. The anatomical accuracy and durability of casts makes them powerful tools to accelerate knowledge acquisition and strengthens diagnostic abilities for medical students utilizing wider variety of learning strategies. By preparing corrosion casts it is possible to trace the path and correlations of the blood vessels and the structure of capillaries. Casts for anatomical structures aim to elucidate otherwise complex anatomical spatial relationships **(Henry et al., 1998)**[1]. They offer 3D information not readily discernible from 2D pictures or gross specimens. These 3D replicas are based on real specimens to support the learning process **(Aultman et al 2003)**[2] rather than learning from theoretical descriptions **(Henry, 1992)**[3].

Aim:

Preparation of corrosion casts of kidney using cellulose acetyl butyrate (CAB) granules for greater understanding of the spatial relationship of renal vasculature by UG students

Objectives:

- To accelerate knowledge acquisition
- To determine student's perception to the utility of corrosion casts of kidney in UG teaching

Methodology

The corrosion cast technique involves injection of the cast material (non sticky) dissolved in the volatile solvent into the hollow blood vessels. Gradually, the volatile solvent evaporates and the solute solidifies inside the vessel forming solid permanent cast. The unwanted tissues are then washed away using corrosive agents like conc. HCl resulting in three dimensional representation of blood vessels.

Preparation of the cast material

CAB granules are available in different colours **(Figure 2)**. Here, we used red granules for artery and blue for the vein. The granules were dissolved in 90% acetone (volatile solvent) and left for 48 hrs. After that they were stirred with a glass rod to make a homogenous coloured solution which was ready to use. The casting medium was made less viscous so that it could flow easily into the capillaries and remain non sticky.

Earlier calcium acetate was used as casting medium but nowadays CAB is preferred because with calcium acetate uniform solution was not formed resulting in formation of non uniform cast and also it was sticky preventing uniform injection of the casting solution.

Pre casting treatment

Fresh specimen is a prerequisite to prepare an ideal cast. **(Figure 2)** Formalin-fixed specimens cannot be used. The specimen was washed under running water to remove any blood clots. The renal vessels were exposed by careful dissection and were cleaned thoroughly.

Injection of Casting Media

The casting material was injected into the vessels according to the colour code with the help of disposable syringes attached to plastic cannulas. The injection was continued until a resistance was felt. Leakage was avoided at the site of injection as it would polymerize and give a false picture. The vessels were clamped and ligated following the injection. The specimens processed with CAB granules were kept at -25 degree C so that the solution settled down in each vessel uniformly. Next day, the specimens were brought to room temperature and washed with tap water.

Maceration

The specimens were then immersed in a large glass container containing 50% hydrochloric acid or freshly prepared 10% potassium hydroxide for 5-7 days and then left in boiling water for 8-12 hours to detach tissues from the polymer. Following maceration in boiling water, the specimens were placed in 5% hydrogen peroxide for about 2 hours to complete the removal of residual tissues. The acid gradually corroded the surrounding tissue. Time taken for corrosion will depend on the size of the specimen. Once the corrosion process was completed, the corroded cast was washed gently and with a fine forceps all debris was removed to finally get an intact well-formed cast. **(Figure 3)**

Methodology

The 1st year MBBS students were divided in 2 groups randomly having 75 students each. Informed consent was taken from the students and scientific and ethical clearance was taken for the study. Half of the total participants received teaching lessons through a lecture discussing renal arterial blood supply using corrosion casts, while rest with 2D images. The other aspects of teaching session, including content, teaching slides were kept identical in both batches. Crossing over was done for teaching venous drainage of kidney. (**TABLE 1&2)**

Results & Conclusion

Post session questionnaires in the form of ten MCQs were applied to assess knowledge acquisition. **(TABLE 3)** Comparison of knowledge acquisition scores of test taken was done by unpaired t test. Mean scores in the interactive lecture method was 7.56 (SD 0.92) & 7.46 (SD 0.95). Mean scores in the intervention group was 7.8 (SD 0.85) & 7.6 (SD 0.94)

The p value in the two groups was non significant.

Feedback was taken of student's perception on the utility of corrosion casts as an effective teaching – learning method on Likert's scale (Strongly agree **SA**, Agree **A**, Neutral **N**, Disagree **D**, Strongly disagree **SD**). Results were converted into percentage and analysis of feedback was done. (**TABLE4 & 5)** The sessions with corrosion casts helped the students to understand the blood supply of kidneys and helped in understanding of basics than memorization. The approach was interesting and they wanted to have more such sessions in future as well.**(Figure 1)**

Corrosion casts are tools to accelerate knowledge acquisition however no significant difference in the 2 groups mean scores was noted in the study. This suggests

that interactive lecture method is an equally effective means for knowledge acquisition.

However, corrosion casts enhance the student's skills in spatial visualisation of complex vascular relationships. This can be used for other topics as well.

Table 1:

Batch	Topic	Teacher	T-L Method
A	Arterial supply of kidney	1	Interactive Lecture Method
B	Arterial supply of kidney	2	Corrosion cast

Table 2:

Batch	Topic	Teacher	T-L Method
A	Venous drainage of kidney	1	Corrosion cast
B	Venous drainage of kidney	2	Interactive Lecture Method

Table 3: Comparison of Knowledge acquisition scores of test taken after session by unpaired t test

Topic		N	Mean score	SD	P value
Arterial supply of kidney	**Control (Interactive Lecture Method)**	**50**	**7.56**	**0.92**	**NS**
	Intervention (Corrosion casts)	**50**	**7.8**	**0.85**	
Venous drainage of kidney	**Control (Interactive Lecture Method)**	**50**	**7.46**	**0.95**	**NS**
	Intervention (Corrosion casts)	**50**	**7.6**	**0.94**	

Table 4: Perception of Students on use of Interactive Lecture of kidney vasculature in UG teaching (in %) LIKERT'S SCALE

(Strongly agrees **SA**, Agree **A**, Neutral **N**, Disagree **D**, Strongly disagree **SD**)

S.No	Questionnaires	Percentage of Student's responses				
		SA	A	N	D	SD
1	Session helped me to understand the blood supply of kidneys	**20**	**60**	**10**	**10**	**0**
2	Session helped in understanding of basics than memorization	**20**	**20**	**20**	**40**	**0**
3	Approach is interesting	**0**	**40**	**30**	**20**	**10**
4	Session motivates me to study more about the topic	**20**	**30**	**40**	**0**	**10**
5	Session was enjoyable	**0**	**40**	**30**	**20**	**10**
6	Session effectively fulfils the learning objectives	**20**	**30**	**30**	**20**	**0**
7	Session helps to apply knowledge to different clinical cases	**10**	**20**	**30**	**30**	**10**
8	Method encouraged me to be more communicative	**0**	**20**	**30**	**50**	**0**
9	Would like to have more such sessions	**20**	**30**	**40**	**0**	**10**
10	Session facilitates interaction between the teacher and students	**20**	**30**	**50**	**0**	**0**

Table 5: Perception of Students on use of corrosion casts of kidney vasculature in UG teaching (in %)

LIKERT'S SCALE (Strongly agree **SA**, Agree **A**, Neutral **N**, Disagree **D**, Strongly disagree **SD**)

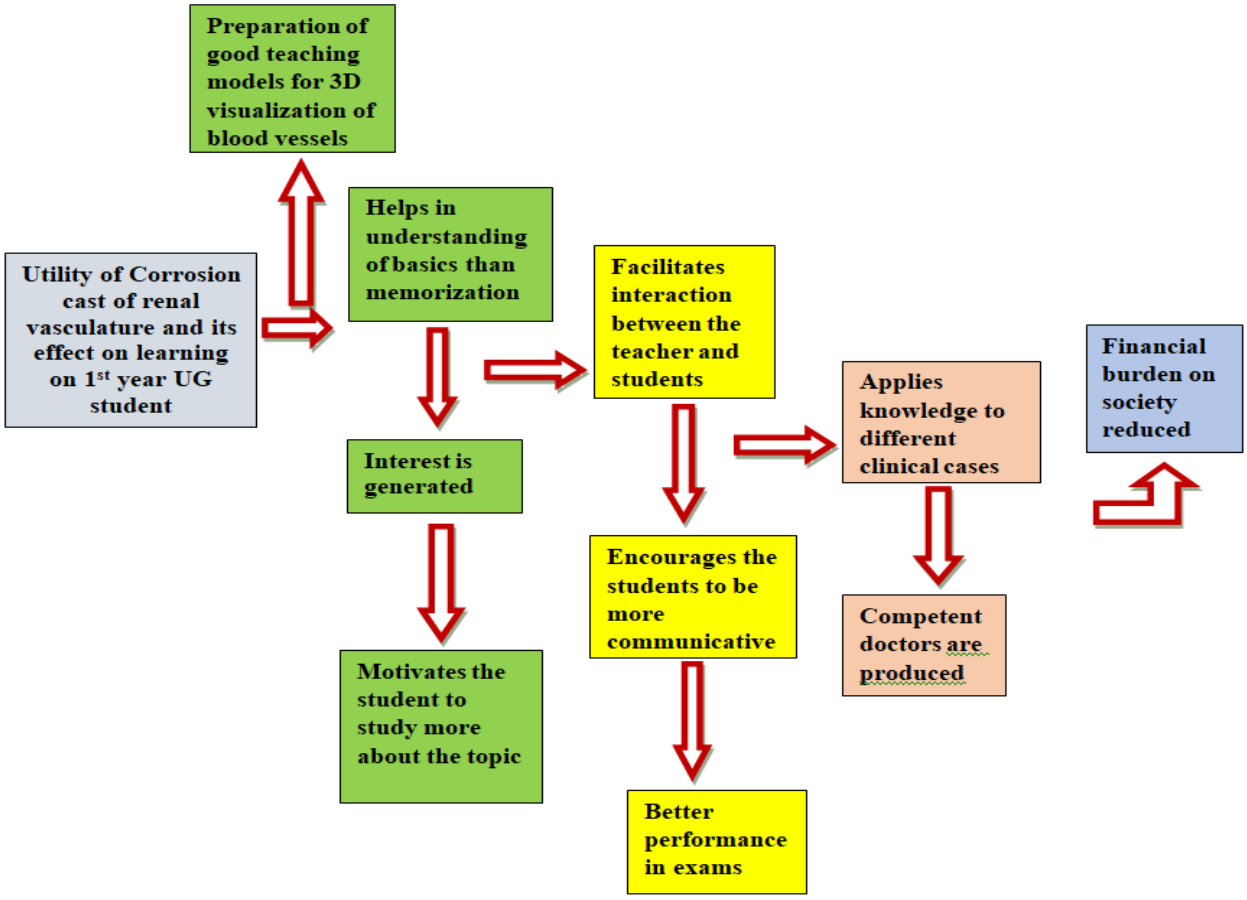
S.No.	Questionnaires	Percentage of Student's responses				
		SA	A	N	D	SD
1	Session helped me to understand the blood supply of kidneys	**80**	**20**	**0**	**0**	**0**
2	Session helped in understanding of basics than memorization	**60**	**40**	**0**	**0**	**0**
3	Approach is interesting	**70**	**30**	**0**	**0**	**0**
4	Session motivates me to study more about the topic	**30**	**50**	**20**	**0**	**0**
5	Session was enjoyable	**50**	**40**	**10**	**0**	**0**
6	Session effectively fulfils the learning objectives	**50**	**30**	**20**	**0**	**0**
7	Session helps to apply knowledge to different clinical cases	**40**	**30**	**30**	**0**	**0**
8	Method encouraged me to be more communicative	**30**	**30**	**30**	**10**	**0**
9	Would like to have more such sessions	**80**	**20**	**0**	**0**	**0**
10	Session facilitates interaction between the teacher and students	**50**	**20**	**20**	**10**	**0**

OUTCOME CHAIN

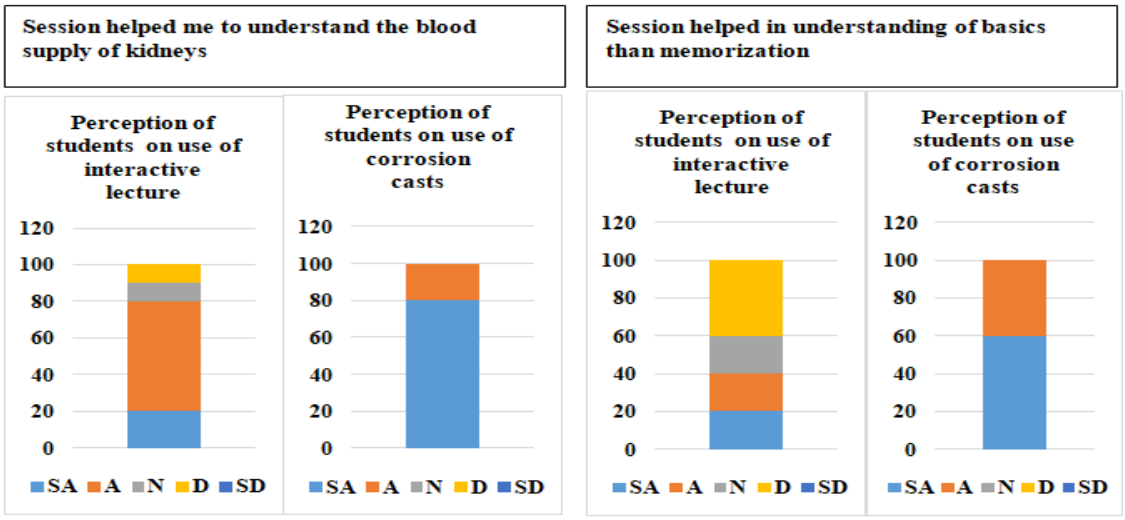
The outcome which is expected in terms of short term, intermediate term and long term is depicted in the **CONCEPT MAP** below.

Short term outcome **Long term outcome**

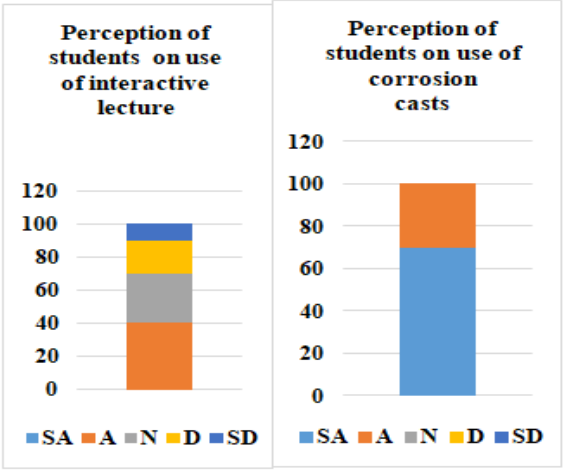
Intermediate outcome



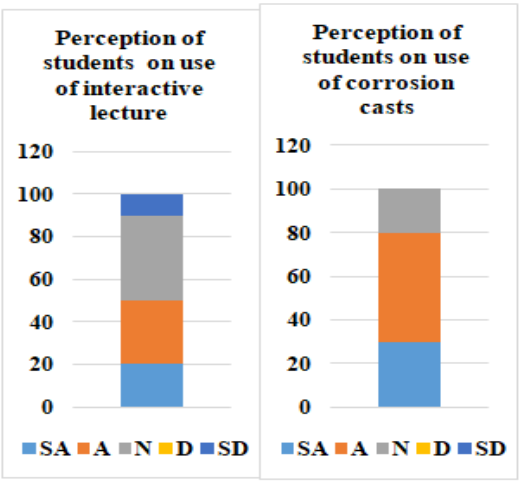
Graph 1: Graphical representation of student's perception



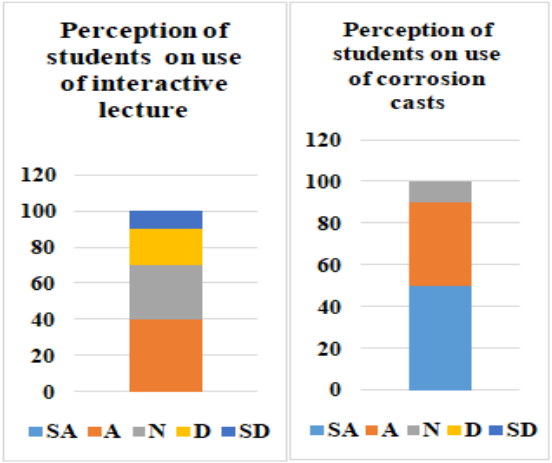
Approach is interesting



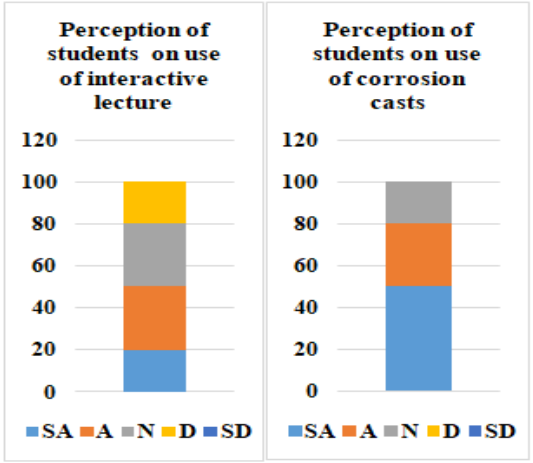
Session motivates me to study more about the topic



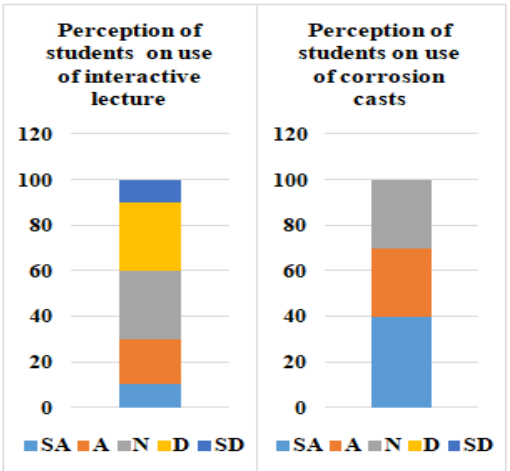
Session was enjoyable



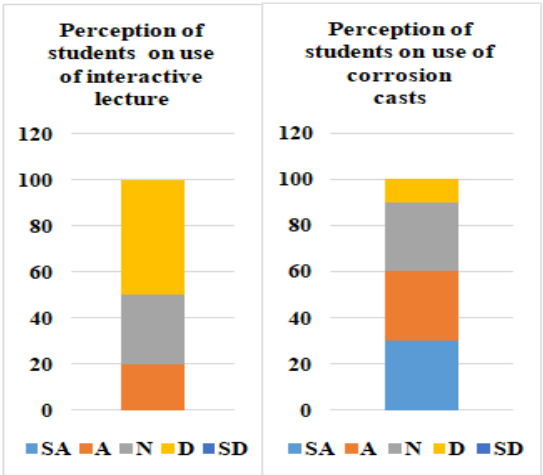
Session effectively fulfils the learning objectives



Session helps to apply knowledge to different clinical cases



Method encouraged me to be more communicative



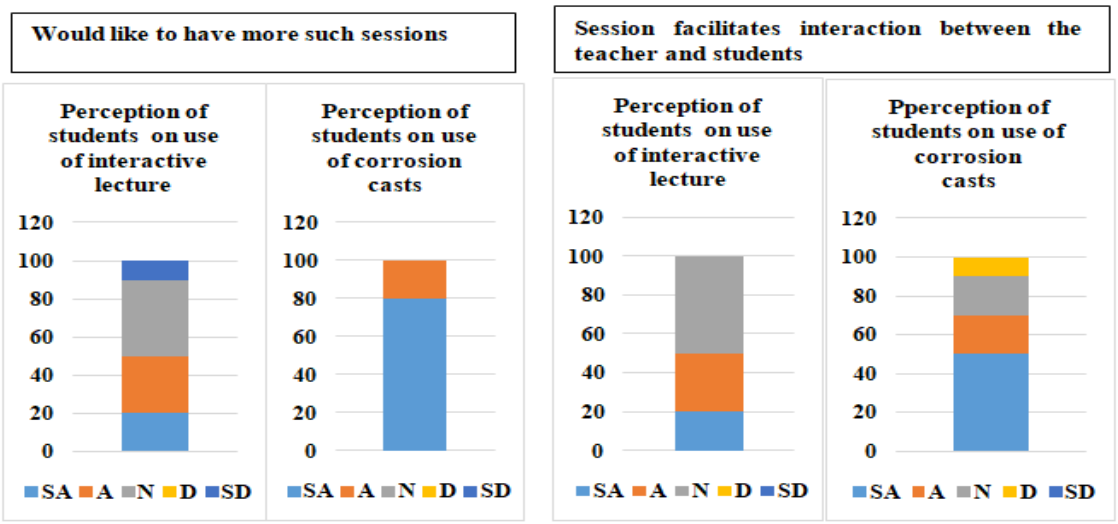


Figure 1: Graphical representation of student's perception

Figure 2:

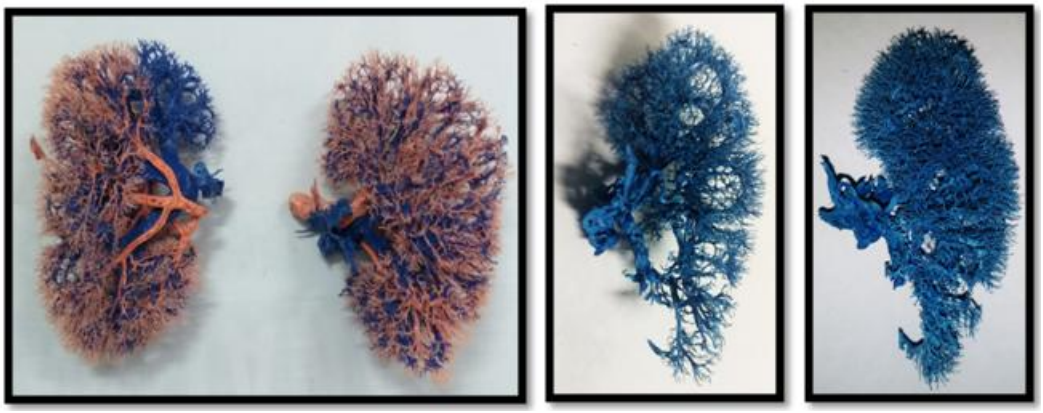


Figure 3: Corrosion casts of kidney

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