

# Early foetal development of the articular disc in the human temporomandibular joint

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*In fetuses of 9 and 10 weeks the articular disc presents a more cellular structure with bands of connective tissue fibres. It is connected with the articular capsule and lateral pterygoid muscle. During weeks 11 and 12 there is an increase in collagenous fibres and fusiform cells are located mainly close to the surface of the disc.*

**Key words:** human temporomandibular joint, foetal period, development, articular disc

## INTRODUCTION

The temporomandibular joint, a distinctively mammalian feature, consists of the mandibular condyle, a part of the squamous portion of the temporal bone and an intermediate disc. The articular disc is a fibrous plate that varies in thickness in its different parts and on the periphery is incorporated into the articular capsule, which divides the joint into two parts. The upper surface of the articular disc fits the articular tubercle and fossa, whereas its inferior surface is adapted to the mandibular head.

The temporomandibular joint disc is composed of approximately 80% water and 20% fibrous, mainly collagen, components [17]. Studies on the human disc have been concerned with its macroscopic structure [2, 5, 8, 15], microscopic and immunohistochemical structure [3, 6, 7, 10–12, 18, 19] and the reorientation of discal fibres to accommodate the direction of tensile stresses [1, 6, 16, 17].

The central part of the disc is thinner as compared to its periphery. The posterior border is the thickest part and its thickness is correlated to the prominence of the articular eminence. Histological study shows that the anterior part of the disc is avascular and is composed of woven fibrous tissue,

whereas the posterior part is of looser texture and may be subdivided into an upper zone rich in elastic tissue and a lower zone, which has many large blood vessels [2].

The variation in structure within the disc has important functional implications. The structural organisation of the collagen fibres is thought to correspond to the mechanical function of the disc [6, 16].

The foetal development of the disc in the temporomandibular joint has been described in fetuses from the 12<sup>th</sup> week onwards [4, 9, 13, 14, 20–22] with particular attention to the relationship of the disc to the lateral pterygoid muscle.

The aim of the present study was to investigate the shape and histological structure of the articular disc within the temporomandibular joint in human fetuses aged between 9 and 12 weeks.

## MATERIAL AND METHODS

The study was performed using 14 fetuses ranging from 9 to 12 weeks of age (Table 1, 2). All fetuses were from the collection of the Department of Anatomy at the University School of Medical Sciences in Poznań. 6 fetuses aged 9 to 12 weeks were fixed in 10% buffered formalin, decalcified in 10%

**Table 1.** Crown–rump length, sex, and age of fetuses in which the temporomandibular joint was dissected and removed for histological sections; f — female, m — male

No.	Crown-rump length in mm	Sex	Age in weeks
1	34	f	9
2	38	m	9
3	55	f	10
4	60	m	10
5	65	m	11
6	75	f	11
7	77	f	12
8	79	f	12

**Table 2.** Crown-rump length, sex, and age of fetuses which were embedded *in toto* and sectioned serially; f — female, m — male

No.	Crown-rump length in mm	Sex	Age in weeks
1	33	f	9
2	40	m	9
3	49	f	10
4	68	m	11
5	75	f	11
6	80	f	12

EDTA, embedded in paraplast and serially sectioned at 5  $\mu\text{m}$  thickness. In 8 fetuses the temporomandibular joint was dissected and the articular disc with the articular surfaces were taken out, embedded in paraplast and serially sectioned. The sections were stained with haematoxylin and eosin with cresyl violet, according to the Mallory method, and impregnated with silver salts.

In some embryos graphic reconstructions were made.

## RESULTS

In fetuses at 9 and 10 weeks the formation of the articular cavity of the temporomandibular joint can be observed. Small spaces that are present between the articular disc and the mandibular condyle in fetuses aged 9 weeks coalesce during the 10th week and the lower joint cavity is formed (Fig. 1). At this period of development the upper joint cavity appears in the form of discontinuous narrow spaces between the articular disc and the ossifying temporal bone. Both joint cavities are seen to be well developed in fetuses of 11 and 12 weeks (Fig. 2, 3).

The articular disc in fetuses aged 9 and 10 weeks has a more cellular structure with an irregular arrangement of fibres. It is connected to the articular capsule and the lateral pterygoid muscle (Fig. 1). In fetuses at the 11<sup>th</sup> week the disc consists of fusiform cells, which are located mainly on its surface, and densely arranged collagenous fibres (Fig. 2). During the 12<sup>th</sup> week the shape of disc changes and at this stage it consisted of a thinner central part and a thickened peripheral part (Fig. 3). During the investigated period of development many blood vessels were observed in the articular disc of the temporomandibular joint, particularly in its posterior part.

## DISCUSSION

It is known that the disc blastema of the temporomandibular joint is formed at the end of the human embryonic period [9, 21].

According to Furstman [4], the articular disc is formed between 12 and 14 weeks. At this time, as was found in our study, the disc is well formed and completely separated from the articular surfaces. It also becomes more fibrous in structure at the end of the 12<sup>th</sup> week.

Thilander [19] noted that with the advancement of development there is a progressive decrease in cellularity and an increase in collagen in the disc. It is evident that the structural elements of the temporomandibular joint develop from different primordia and that they are widely separated at the beginning.

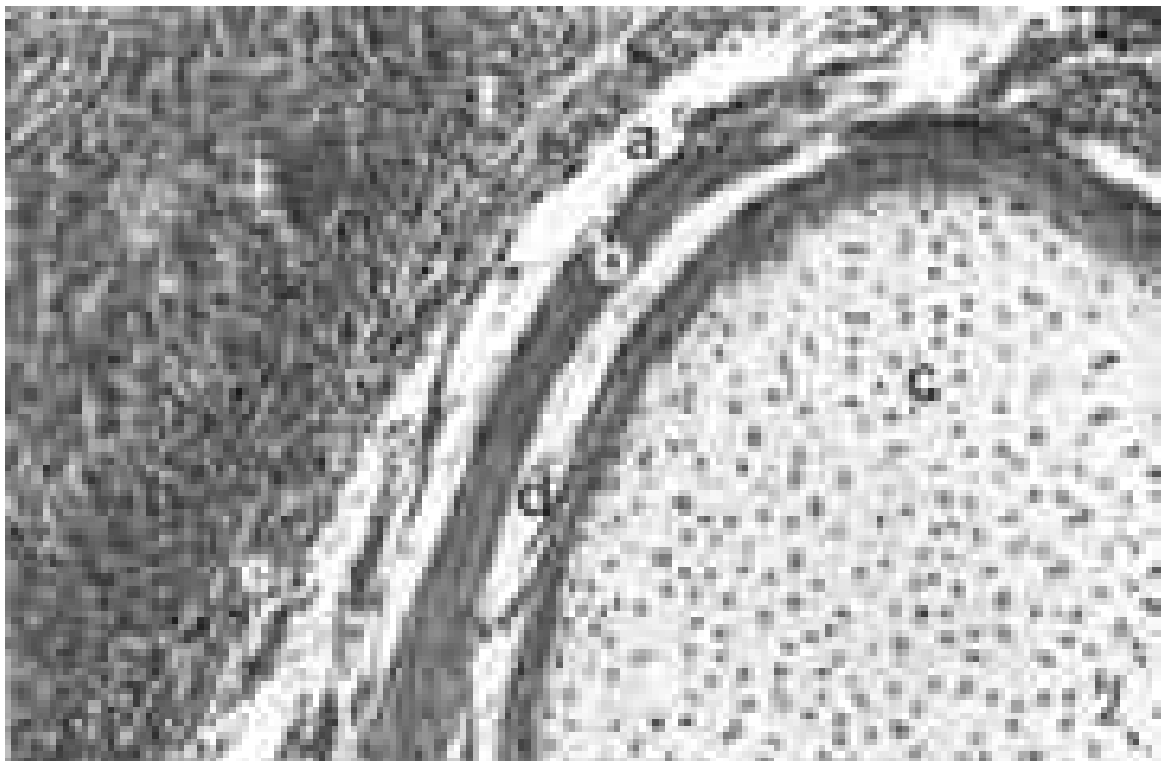
It is evident from the performed investigations that the critical period in the development of the articular disc is between 9 and 12 weeks. During this period the disc becomes a completely separated structure and changes in thickness in its central and peripheral parts.

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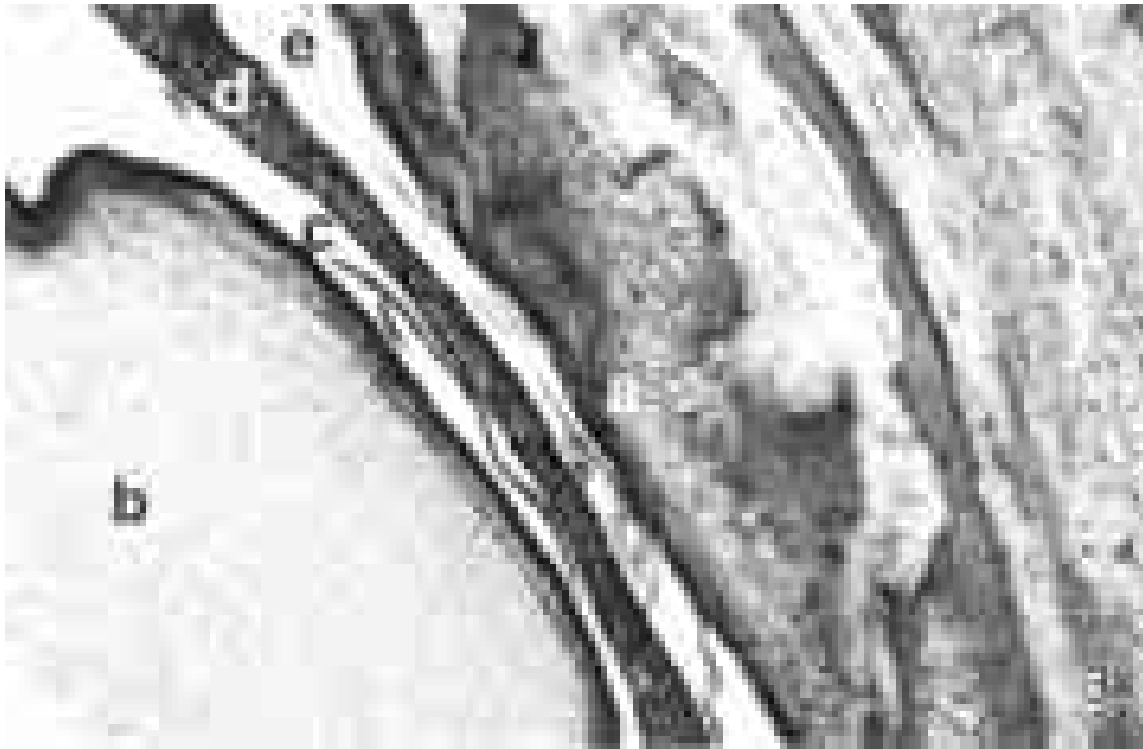
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**Figure 1.** Transverse section of the temporomandibular joint in a foetus aged 10 weeks. Stained with haematoxylin and eosin.  $\times 110$ ; a — temporal articular surface, b — articular disc, c — articular capsule, d — lateral pterygoid muscle, e — head of mandible, f — inferior articular cavity.



**Figure 2.** Sagittal section of the temporomandibular joint in a foetus aged 11 weeks. Stained with haematoxylin and eosin.  $\times 110$ ; a — superior articular cavity, b — articular disc, c — head of mandible, d — inferior articular cavity, e — temporal articular surface, f — zygomatic process.



**Figure 3.** Sagittal section of the temporomandibular joint in a foetus aged 12 weeks. Stained according to the Mallory method.  $\times 110$ ; a — temporal articular surface, b — head of mandible, c — inferior articular cavity, d — articular disc, e — superior articular cavity.

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